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Modification in Tank Design and Construction

By I. O. Pederson[1]

We do not believe that in the present conventional designs of tanks, the free open volume above the glass in the melting end is filled with gases of the required melting temperatures. The crowns of these tanks are so high that the gases remain in the tank too long and in cooling reach a temperature point in the tank when, instead of giving up heat, they absorb it from the newer and hottest gases, from the brickwork and from the glass itself. There is also a constant inflow of outside air into the furnace absorbing heat. Obviously such a condition is a misuse of fuel.

As between a high crown and a low crown, it is now generally recognized that a low crown is to be preferred and tanks having had their crowns lowered have consistently consumed a lower percentage of fuel, but so far as we are aware, no work has been done to define the point to which the crowns may be lowered. The theory of the high crown was to permit the fuel sufficient time to remain in the furnace to effect complete combustion and to secure the maximum of radiated heat. We believe these theories wrong as applied to a glass melting tank, to the same degree that they have been proven wrong in the steel industry.

With the conventional design of tank, the hot gases of combustion fill only a minor portion of the open space in the hearth above the glass. These gases do not flow along the surface of the glass, because being the lightest gases they seek the highest point in the tank, that is immediately under the crown.

Fig. 1 shows a conventional design of melting tank. The rated output, figuring a ton of glass to 15 sq. ft. of melting area, is 129.5 tons per 24 hours. Using 15,000 cu. ft. of natural gas with 25% excess of combustion air to melt one ton of glass, the volume of the gases of combustion will be 1,551 cu. ft. per second at an average furnace temperature of 2565°F. This 2565°F. is an average of 2730°F. as the actual temperature of combustion and 2400°F. as the temperature of the waste gases. The volume above the glass in the melting end is 11,619 cu. ft.., 52% of which is contained above a line drawn from the lowest part of the skewbacks supporting the crown. Disregarding the refining end of the tank in this instance, it follows that the gases apparently remain in the furnace 7.49 seconds. This is too long, for before this time they will have been cooled to the point when they start absorbing heat. It is impractical to use the stack draft to pull these gases out before they have cooled, because vast quantities of outside air would be pulled into the tank. If the refining end of the tank is included in this consideration, it is seen that the sojourn of the gases will be increased in the furnace far beyond 7.49 seconds, which is, of course, what happens.

We believe that the normal conditions within the conventional glass tank operated in the usual manner, are as follows:

The hot gases of combustion flow immediately under the crown to a depth determined by the fuel supplied. As these gasses cool, they drop, and after a certain length of time, begin to absorb heat from the newer gases, the brickwork and the glass. In the region of the hottest gases there is a furnace pressure greater than atmospheric due to the hydrostatic pressure of these gases. At the glass level and for some distance up to a point of equilibrium, the pressure is less than atmospheric, due to the stack draft effect in the exit port, which in many tanks extends clear through the furnace. The stack draft will not draw a column of hot gases of combustion through the furnace from the ports which would completely fill the free volume above the glass, because the supply of these hot gases is not available in this quantity, as for example, with the tank shown in Fig. 1 when figured as consuming 15,000 cu. ft. of natural gas per ton of glass and 129.5 tons as the output of the tank per 24 hours. The draft will draw the heavier and colder gases and the outside air through the furnace near the glass level. The continuous drawing of cold air into the furnace is particluarly bad as it lowers the furnace temperature by absorbing heat and it retards combustion. Considering the proportion of the volume of the gases of combustion to the free volume of the tank, there is scarcely any question but that a large volume of the tank is filled with chilled gases and cold incoming air, since it is obvious that a vacuum can-

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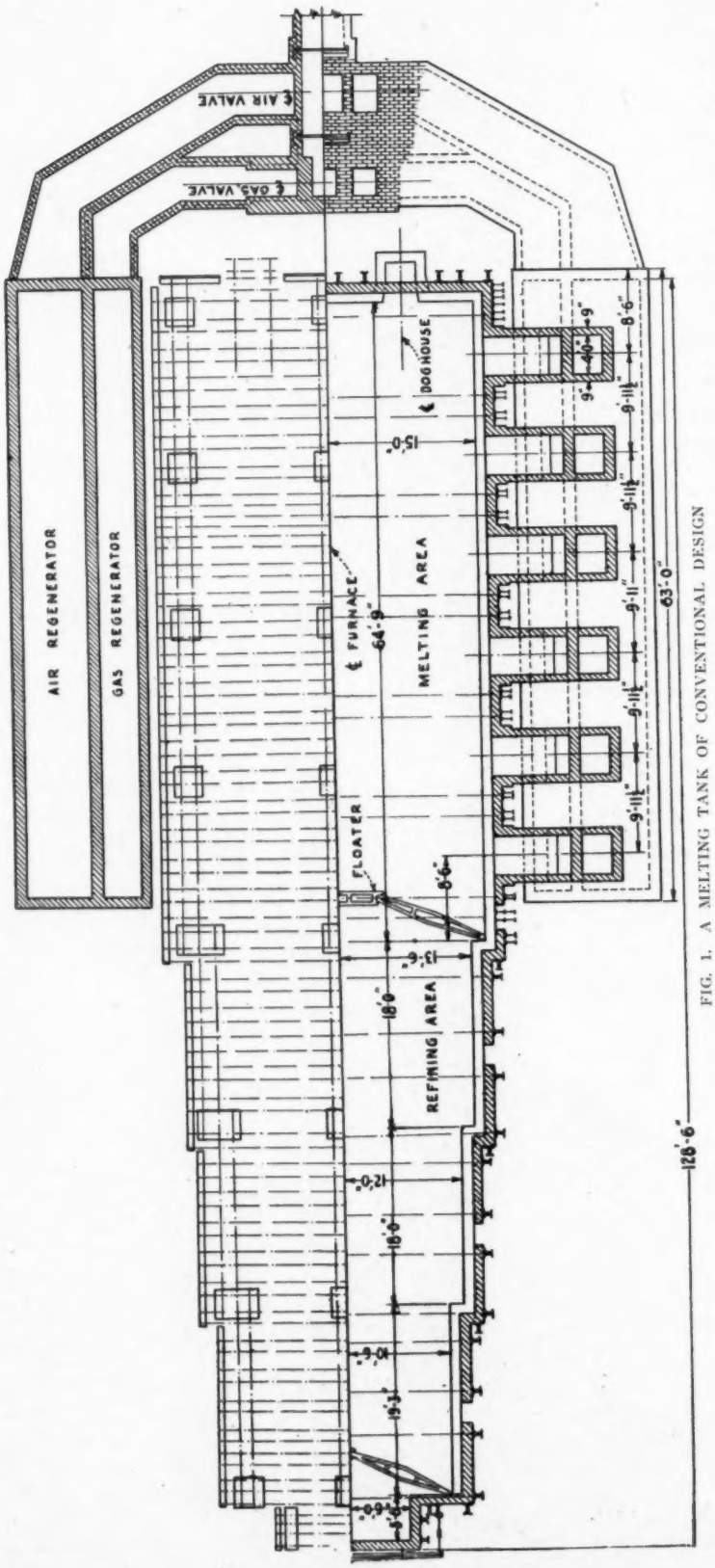


FIG. 1. A MELTING TANK OF CONVENTIONAL DESIGN

not exist in the tank. (The gases given off by the batch can be disregarded as their volume is negligible). The chilled gases and the incoming cold air form what amounts to an insulating blanket between the hot gases and the glass. The incoming cold air immediately absorbs heat. As it absorbs heat, it becomes hotter and moves up and away from the glass while its place will be taken by outside air entering the hearth. Such convection currents moving up diffuse with cooling gases which are dropping as they lose their heat. It will be seen that there is very little opportunity for melting the glass by convection currents of the gases for the reason that the hot gases never reach the glass because of the heavy outside air entering the furnace and forming a blanket over the glass.

Even assuming that the outside air does not enter the furnace, the cooled and heavier gases which would reach the glass level have been in the furnace so long that they have lost any useful heat for transference to the glass, except by radiation, and would long before have started to absorb heat.

Consequently the glass is melted almost wholly by radiation from the gases and brickwork.

The presence of this air and the cool gases intermediate the glass and the hot gases has been neglected and is the main cause of the high fuel consumption in glass tanks and has considerable to do with their irregular operation.

The fact of the distribution of various diffusing layers of gases and air at various temperatures within the furnace, with the hottest gases immediately under the crown and the coolest at the glass level, will be readily seen from a consideration of the weights of air and gases of combustion of a particular gas with 25% excess of combustion air, at the following temperatures:

POUNDS PER CUBIC FOOT

	Air	Gas	Gases of Combustion
32° F.	0.080723		0.073252
62° F.	0.076097	0.0435	0.069044
1832° F.	0.017283		0.015682
2400° F.	0.013856		0.012569
2565° F.	0.013037		0.011881
2730° F.	0.012415		0.011265

If the free volume above the glass could be maintained completely filled with the gases of combustion at correct temperatures above the required glass temperature, there would be a hydrostatic pressure within the furnace greater than that of the atmosphere and outside air could not enter the tank.

Further, and more directly to the point of our contentions, if the hot gases of combustion could completely fill the free volume of the hearth and travel in a column from entry to exit ports, the gases would flow over the glass in contact with it and thus the glass would be melted by radiation, conduction and convection, instead of as at present, almost wholly by radiation.

Very often, in the use of producer gas, it will appear as though the gases of combustion actually do flow quite close to the glass surface. What really occurs is that the hot and non-luminous gases rise while the luminous flame observed is caused by glowing carbon particles floating in the gas, which, because of their weight, do not tend to rise.

A great number of calculations have been made to try to establish the point that the chilled gases and outside air drawn into the furnace absorb heat. This we can do by inference only, but we believe that the figures show us to be correct.

A heat balance of the tank shown in Fig. 1 has been made on the assumption that 15,000 cu. ft. of natural gas will melt one ton of glass, that 15 sq. ft. of melting area are necessary to melt one ton of glass per 24 hours and that the output is 129.5 tons of glass per hour. The 1,500 B.t.u. figured to melt one pound of glass is a liberal figure, even for a batch requiring a high temperature, less than 1,200 B.t.u. would be nearer the required heat.

HEAT BALANCE

	B. t. u. per hour
Latent heat of gas, 957 B. t. u. per cu. ft., higher value	77,456,709
Sensible heat of air, with 25% excess, preheated to 1832° F.	32,071,286
To furnace	109,527,995
Waste gases at 2400° F	59,893,380
Available in furnace	49,634,615
Required to melt glass, 1,500 B. t. u. per lb. of glass	16,188,000
Lost in furnace	33,446,615
Lost through furnace walls	17,650,243
Unaccounted for losses	15,796,372

Of this total of 15,796,372 B.t.u. per hour unaccounted for, some are lost through the crown and breast-walls not being perfectly tight, "sting-outs," and radiated heat from the dog-house, skimming holes and working openings, but by computation these losses are comparatively small. The various furnace openings are close to the glass surface where the furnace pressure is negative and consequently air is drawn into the furnace rather than hot gases escaping, except indirectly by radiation. Radiation losses of this kind are small.

In no other way, except through the absorption of heat by the chilled gases of combustion and the incoming cold air, can we account for these large unclassified heat losses.

The figures in the above heat balance are not to be accepted without reservation. They have been computed, however, by the use of data accepted as the most reliable that we have today for heat transmission through clay and silica brickwork.

The tabulated losses for each part of the furnace are not included here. The following general data was used:

Bottom blocks; 9" thick, 1500°F. in the melting end, 1300°F. in the refining end.

Side and rear blocks; lower 3' as 6" thick and 1700°F., upper 2' as 4.5" thick and 2500°F. in the melting end; lower 3' as 6" thick and 1700°F., upper 2' as 4.5" thick and 2000°F. in the refining end.

Silica cap; 9" thick, 2730°F. in the melting end, 2415°F. in the refining end.

Breast-walls; 9" thick, 2540°F. in the melting end, 2350°F. in the refining end.

These temperatures are in excess of normal conditions and if the recognized formulas for the transmission of heat

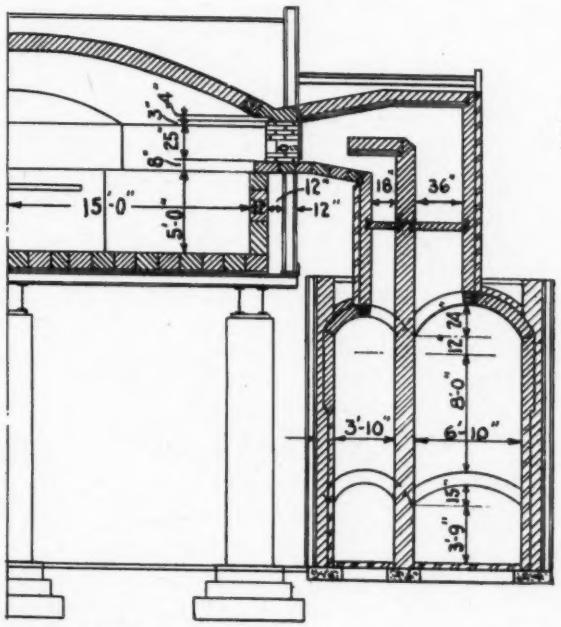


FIG. 2. TRANSVERSE SECTION OF TANK SHOWN IN FIG. 1

through clay and silica have any basis in fact, the total of 17,650,243 B.t.u. per hour should amply cover all such losses of heat.

The losses are divided as follows:

Melting end—Substructure	3,978,069	
Superstructure	6,531,587	
		10,509,656
Refining end—Substructure	2,358,018	
Superstructure	4,782,569	
		7,140,587
		17,650,243 B. t. u.

The heat given off by the glass in the refining chamber in the process of cooling to working temperature, which in this case amounts to 5,068,347 B.t.u. per hour, was not balanced against the calculated heat losses through the walls, bottom and cap of the refining end.

As constructed at present it is impossible to build a practical furnace in which the gases of combustion at proper temperatures completely fill the free space of the hearth, in a regenerative cross-fire tank, because of the difficulty

in supporting a crown so close to the glass level. Another factor enters; the gases should be evacuated from the tank at a temperature greater than the glass, say at 2400°F., and before they have dropped below this figure. It follows that the width of the tank should be such as to permit the travel and cooling of the gases to this temperature. At this point it appears that the width of the tank is a vital factor. If the tank is not wide enough the gases will escape before giving up their heat in the furnace and before combustion has been completed. If the tank is too wide the gases will cool to a point when they absorb heat and as an excessive width means an excessive furnace volume, outside air will be admitted. From this it would appear that the width is a constant value and that the length of the tank is the determining factor of its rated capacity.

It is obvious that with the low crowns and long distance between entry and exit ports which are indicated by the above, that structural difficulties make it apparently impossible to apply these principles in a tank of conventional design. Any attempt to build the usual type of tank 55′ to 65′ wide would result in a greatly increased free volume above the glass.

We have conceived a new type of melting tank which is shown in Fig. 3 and in the following explanation of this tank, further points will be brought out.

As will be noted the melting end has some features peculiar to an open hearth steel furnace. The opposing ports carry the gases through the long dimension of the tank, instead of as hitherto through the short dimension. Instead of a number of ports on each side of the furnace, there is only one big port at each end. This should be an improvement over the usual construction in which the gases escape from a number of ports, between which there is a volume of cooler gases.

There are two dog-houses, one at each end of the tank. In operating the tank, batch is filled in shortly after gas reversal through the dog-house adjacent the port of entry of the gas. By this arrangement the regenerators will not be clogged up so quickly, as in order to pass into the checkerwork, batch particles and volatilized silica and soda will have to travel a distance of some 50′ or more with the gases.

The tank shown in Fig. 3 has a surface area of 851 sq. ft. in the melting end and assuming a melting [illegible] sq. ft. per ton of glass per 24 hours, the rated [illegible] ould be 62 tons, say 65 tons, per 24 hours. Figu[illegible] fuel consumption of 15,000 cu. ft. of natural [illegible] B.t.u. (higher value) with 25% excess of combustion air per ton of glass melted, the volume of the products of combustion at an average furnace temperature of 2565°F. will be approximately 780.8 cu. ft. per second.

It is this 780.8 cu. ft. of gas per second which has been used as the basis of calculation, as the glass melted in this tank is an uncertain quantity.

The width of 14.4′ has been determined arbitrarily for purposes of this calculation and in order to secure a width easily spanned by a low crown and fired from a single port.

The height of the crown from the glass has been determined by the Yesmann formula for computing the depth of a gaseous stream, which is:

$$h = A \sqrt[3]{\frac{Q_t^2}{B^2 t}}$$

and for the case in hand.

Q_t = volume of gas at furnace temperature, 780.8 cu. ft. per second.

B = width of furnace, 16.4′

A = a coefficient, in this case 2.38

t = the average temperature in Centigrade degrees, 1407°C.

h = the thickness of the layer of gas in motion.

For our case the height of the gas stream is 2.79′. The cross-section area of the free volume of the furnace is then 45.75 sq. ft., to which we have transposed our design.

The length of the furnace is dependent on the time taken to cool the gases from the temperature of combustion to the temperature at the exit port and the speed of travel of the gases. This point has been studied and a very great number of calculations were made to establish this time, but because of the number of unknown factors we have as yet not reached a definite conclusion. In open hearth furnaces the gases are calculated to cool at the rate of 392°F. per second and to remain in the furnace from 1.5 to 2 seconds, but the rate of heat absorption by iron is greater than that of glass and unfortunately there apparently exist no reliable figures on the conductivity of glass at melting temperatures. From such data as are available and from practical experience we are led to believe that in cooling the gases from 2730°F. to 2400°F. a time ranging between 3 and 4 seconds should be allowed. As it is not essential to a presentation of our ideas to definitely determine this point at present, we will, for convenience, tentatively fix this time here as 3.5 seconds. Then 780.8 cu. ft. × 3.5 = 2732.8 cu. ft. of free volume ÷ 45.75 sq. ft. area of cross-section = 59.7′, the length of the furnace, that is, inside from breast-walls to breast-walls. As the process of combustion should not exceed 2 seconds under conditions in a furnace hearth of this character, this length between ports is ample for practically complete combustion.

If the drop in temperature per second in a glass melting tank of this kind can be determined, the problem of the length of the furnace would be solved. But as we have said, unknown factors enter and at present we cannot fix this. It appears as though the correct length lies between 55′ and 65′ for the tank shown in Fig. 2. Should the length of the tank not be correct, the error will fall between such narrow limits that the fault can be readily corrected by proportionately increasing or decreasing the fuel supply. In the usual type of tank, the volume of the gases of combustion at melting temperatures is so small in proportion to the free volume of the tank, that close control of its working is difficult. Hence, in our tank, the vital factor of the length of the furnace and the time the gases stay in the furnace is under control, something that is a practical impossibility in the usual type of furnace.

The size of the neck connecting the melting and refining chambers has not been figured, nor has the refining cham-

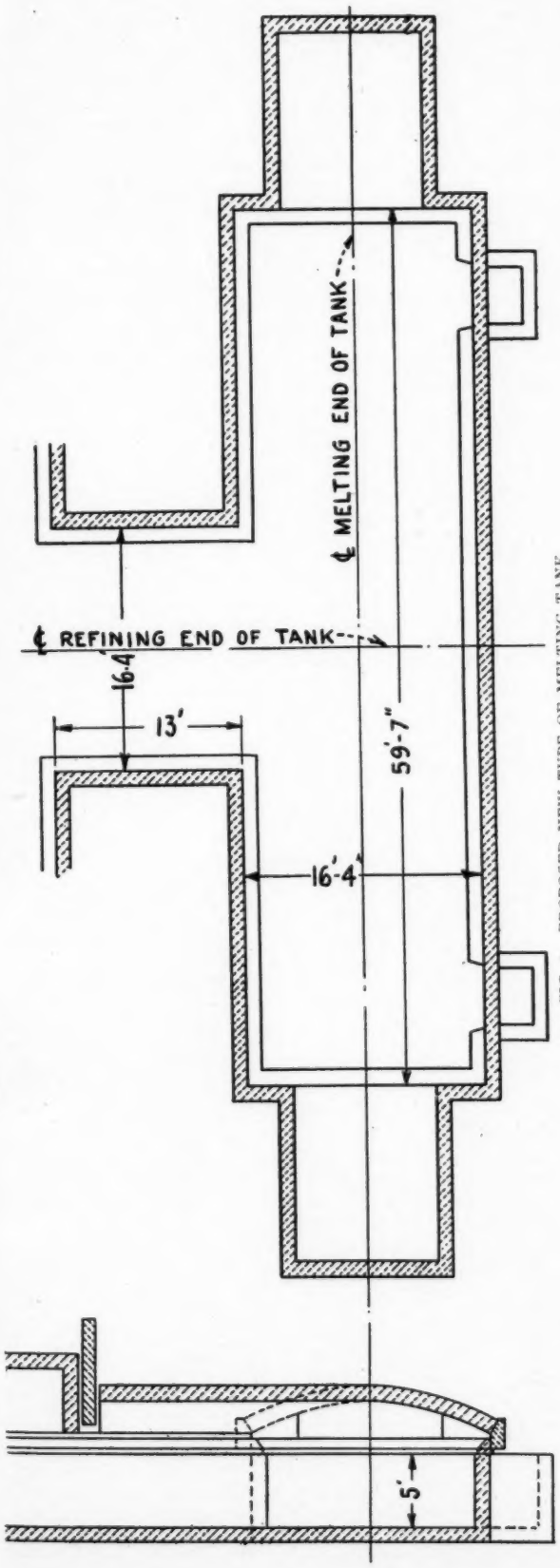


FIG. 3. PROPOSED NEW TYPE OF MELTING TANK

ber. The neck is divided from the refining end by an adjustable shade wall to control the entry into the refining end of such heat as may be necessary from the melting chamber. To make good the deficiency of gas in the melting end due to diverting gas into the refining chamber a proportionate increase in the fuel supply must be provided. To maintain the neck filled with hot gases of combustion an increase of 26% is necessary in the fuel burned, for the size neck shown in the drawing.

In the absence of the usual breast-walls, both neck and refining chamber can be provided with low crowns. The refining end will contain gases of lower temperatures than those in the melting chamber. But because the pressure of the hot gases is greater than those of the cool gases, there will not be an inflow of cool gases from the refining to the melting chamber, but a flow of hot gases from the melting end to the refining chamber according to the height of the shade wall. This must be provided for in the gas supply.

With the output of the tank and the size of the refining chamber uncertain, the heat needed in the refining chamber cannot be computed. Estimating an output of 130 tons per 24 hours, it can be approximated as 2,200,000 B.t.u., the difference between the loss through the furnace walls and the heat given off by the glass in cooling. Allowing 1,300,000 B.t.u. for unforeseen and unpreventable losses, gives a total of 3,500,000 B.t.u. per hour, which should be ample. This would mean an additional 6% in fuel.

In the usual tank, excessive quantities of fuel are necessary in the refining end for the same reason indicated as a defect in the melting end. The free volume is so great that chilled gases remain in, and outside air enters, the furnace and both absorb heat from the hot gases, the brickwork and the glass itself. These losses, in addition to the heat lost through the furnace walls, are greater than the heat released by the glass in cooling and as result, a steady supply of heat must be supplied from the melting end, to prevent rapid cooling.

There is a possibility that by filling in batch from both ends the glass may not be wholly homogeneous, but as the two streams of glass join in the center, where the highest temperatures will be, we feel that this condition need not be anticipated.

Burning 53,625 cu. ft. of natural gas per hour, we may approximate a heat balance for our new tank as follows:

HEAT BALANCE

		B. t. u. per hour
Latent heat of gas, 877 B. t. u. per cu. ft., lower value, and sensible heat of air, with 25% excess, pre-heated to 1832° F.		68,800,875
Waste gases at 2400°F		33,783,750
Available in furnace		35,017,125
Lost through walls of melting end	6,328,787	
Lost through neck, 15' long by 16.4' wide	1,546,877	
Net loss in refining end	3,500,000	
Miscellaneous losses through dog-houses, skimming holes, working openings, sting-outs, etc., by approximate computation 1,000,000 B. t. u., say	5,000,000	
		16,375,664
Available for melting glass		18,641,461

Figuring 1,500 B.t.u. per lb. of glass, this would indicate a capacity for the tank of 149 tons per 24 hours. The fuel burned would be 8,630 cu. ft. of gas per ton of glass.

We do not contend that the tank will equal this theoretical production but it is probable that its efficiency will exceed that of the conventional design of tank in general use. In a general way, from fuel consumptions of some very efficient tanks, it would seem that our figures are not unreasonable.

We have not taken into consideration the possibility of excessive leakage of heat through the more or less porous furnace cap because of what may appear to be an unusual furnace pressure simply because the entire furnace is above atmospheric pressure. Such a pressure exists under all tank crowns as in all tank furnaces the hot gases seek the roof. Only under conditions when more gas is fired in the furnace than its volume is designed to contain, will there be any excessive furnace pressure and leakage of gases through the brickwork. In our present tank, any increase of gas will be made only when necessary for the refining end and such excess supply will flow through the neck and into the refining chamber as designed, instead of exerting any extreme pressure against the brickwork.

Neither the ports nor regenerators have been figured. The chimney draft should be used only to remove the products of combustion from the exit ports, toward which they move under their normal velocities and the pressure exerted by the incoming gases. The draft should not be employed in the furnace hearth and the regenerators should be designed with this point in mind.

Because of the presence of the excess combustion air, it is not to be expected that the ideal condition of a furnace chamber completely filled with the gases of combustion can be realized. The excess pre-heated air will absorb heat and at some time will find the glass level and its retarding effect upon the melting will be in proportion to the percentage of the excess air and its pre-heat temperature. But, however much such action will reduce the efficiency of the furnace, it will only be a fraction of the losses now sustained in the usual type of furnace.

The melting by radiation of the gases in this tank will be greater than that in the usual type of tank. The amount of radiation varies, with other factors, in direct proportion to the thickness of the gas layer. Owing to the flow of the gases from the melting to the refining end in the usual tank, the gas layer is spread under the crown of both divisions of the tank without control and with less thickness than in this new tank, where the gas layer is thicker in the melting end, owing to the control of the passage of gas into the refining end afforded by the adjustable shade wall.

With a furnace of this design the melting chamber will be almost completely filled with the hot gases of combustion at all times and the maximium of heating will be effected through radiation, convection and conduction. The effect of a hot current of gas upon batch and molten glass is so evident from our observation, that we believe a tank designed along these general lines would be successful and an improvement over those now in general use, although in this, our first draft, it may prove that we have not made the best application of these principles. We believe that the glass will be produced uniformly good in quality.

The Laminated Glass Situation

Non-shatterable glass for automobile windows and windshields presents one of the most interesting situations in the glass industry today. During the past three or four years various firms in America have played with the idea but until recently there has been no concentrated effort. In England, on the other hand, non-shatterable glass has caught the public fancy and as a result this new industry has made great strides. Why then has this country lagged behind? According to one well informed observer there are several reasons. One, it is stated, is the fact that there has been no satisfactory process developed in the country. Another is the fact that with the tremendous output of automobiles in this country, no small concern could undertake to supply the market and no large one has seriously attempted to.

As to the process. The most serious problem is to keep the three laminations which go to make up non-shatterable glass from separating. Any number of people can laminate glass which would prove quite satisfactory as far as non-shattering qualities are concerned. They could not, it is claimed, make a laminated glass that would stand the test of time. The result was that either the layers of glass separated or the plastic center clouded over and became opaque.

The oldest manufacturer of this type of glass is the Triplex Safety Glass Company in England. Realizing the real need for a satisfactory laminated glass in America, Amory L. Haskell, well known in the automobile industry, bought out the American rights of this successful English process and established here the Triplex Safety Glass Company of North America. Production was started in November, 1926, and within twelve months the one factory has proved inadequate. So much so that a second factory, which will triple production, has already been started.

The essential although seemingly insignificant basis of success is cleanliness and attention to detail. The whole process is extremely delicate. Many of the features are secret and others are covered by patents. However, a rough idea of the process may be gathered from the following description.

After the glass has been most carefully cleaned, it is processed and a "sandwich" is made up consisting of two layers of glass and a layer of plastic. It is welded into a single piece under heat and great pressure.

Both the plate glass and the pyralin are, of course, cut to size before they are united. In its finished form the glass can only be cut by means of special equipment. This cutting is an extremely skilled job and there is considerable risk of breakage. It is, therefore, essential that sizes be exact.

After the "sandwich" has been laminated, the edges are cleaned out and are sealed with a pitch compound to a depth of about 3/16 inch in order to keep out air and moisture. The glass is then checked up as to size, the edges are polished or beveled to specification and after final inspection the product is complete. Both sheet and plate glass can be used.

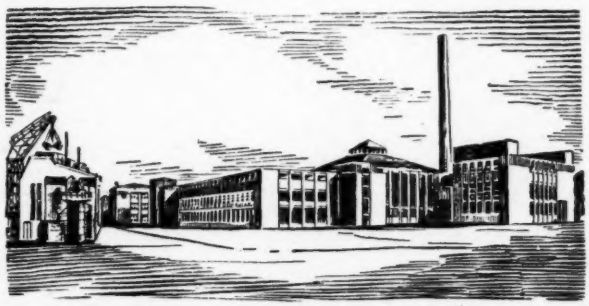
Actually there are 17 different processes involved.

Meeting of German Society of Glass Technology

German Glass Technologists Gather at Berlin

The eighth meeting of the German Society of Glass Technology was held on November 10 and 11, in the Engineering Building, Berlin, Dr. M. von Vopelius occupying the chair. The first day was taken up by meetings of the committees on Physics and Chemistry of Glass, Heat Economy and Furnace Construction, and Glass Working. The second day of the meeting was devoted to the reading of the reports from the various committees, and of the Governing Board; changing of the by-laws and Election of officers, and to the presentation of papers relating to glass technology of which some are reviewed below.

A feature of the meeting was the exhibition of synthetic raw materials for the glass industry. Dr. Gehlhoff gave a



GENERAL VIEW, OSRAM WORKS, SIEMENSSTADT, BERLIN

lecture on the new glass bulb works of Osram, at Siemensstadt-Berlin illustrated by lantern slides. On November 12th the members of the Society visited the Osram works. A few views of the Osram plant are shown here.

On Stress Phenomena in Glass

By F. RINNE, LEIPZIG

The address treated in a general manner the character of primary and secondary stress, which latter, as is known, is of extraordinarily great importance for the use and durability of glasses.

In order to study stresses in glass, and to demonstrate them, use has been made for many years of the exceptionally fine method of observation in so-called linearly polarized light. In recent times this method has been developed more and more and also mathematically. The polariscope gives an insight into condition of the stress that reduces the quality of the glass. A series of diagrams can be constructed, which characterize the conditions which exist. For the easy comprehension of these conditions, the address included the principle of linear-polarized light, with the aid of which a series of stresses, caused by impurities, thermal or mechanical effects, were illustrated in colors and studied in detail. In addition, there was also a demonstration of stress conditions on cutting glass. This opportunity was also taken for explaining the compensation of stresses in glass, resulting from rather long heating (tempering). With the aid of this method, the fracture of glass can be explained as an equalization of a stress, powerful enough to cause breakage.

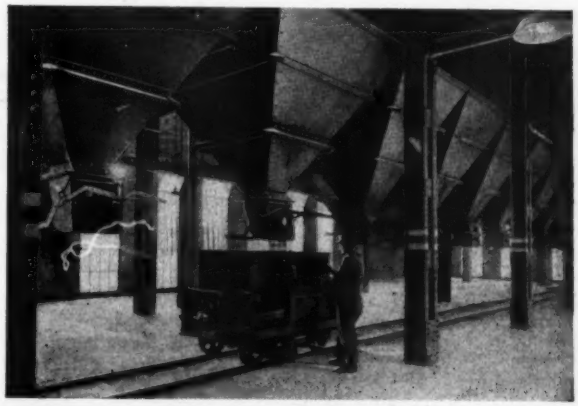
It is hoped that a more thorough insight into one of the most important phases of the glass industry, will lead to further practical results.

Electric Heating of Glass Cooling Ovens

By K. TAMELE, BERLIN

Electric furnaces for annealing and hardening purposes have been used to a great extent in recent years in metal working. Electric furnaces have also been built for enameling purposes. Therefore it seems proper to also test the applicability of electric heating to glass annealing ovens. Although such furnaces have not been built in Germany, in a number of cases they are in operation in America with good results.

In the annealing furnace the glass must first be kept for a time at the stress-relieving temperature, at the end of which there is a slow cooling to the lower limit of the critical zone, after which further cooling can take place more rapidly. The ordinary types of furnaces were discussed briefly. The tunnel annealing furnaces, as compared with the chamber cooling furnaces, have a certain adaptability as regards the maintenance of a desired temperature range. However, the fuel furnace does not give the absolute certainty that the temperature conditions in the oven will undergo no fluctuations. Electric heating on the other hand, which can be adjusted for very small stages, makes it possible for the processes to take place completely at any time.

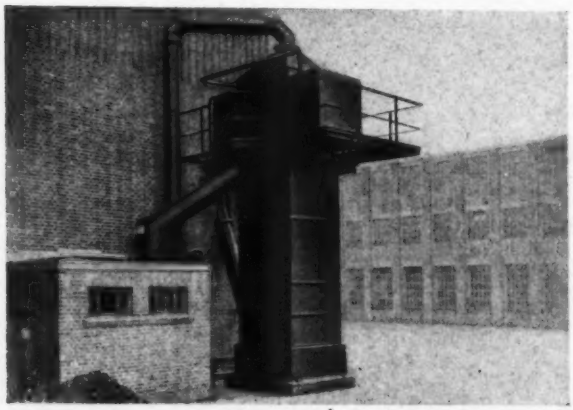


STORAGE BINS FOR RAW MATERIALS AND BATCH SCALE (Osram Works)

Examples of electric heating of annealing and hardening furnaces show that heating resistances of chrome-nickel alloys have great operating safety and long life. The uniformity of the distribution of the temperature can be aided by the special arrangement of the wall surfaces of the heating chamber. For exact maintenance of the constant temperature either regulating transformers or automatic temperature regulating devices are used, in which an alternating connecting and disconnecting of the heating power, or a part of the same, is caused by a temperature-sensitive apparatus.

Electric heating requires, from the very beginning, a

special construction of the oven differing somewhat from the fundamentals of previous designs. As an example, there was described an American annealing furnace for telescope lenses, operating as a chamber oven, in which the annealing temperature is first kept constant for several weeks and then is reduced with the exceptionally small temperature drop of 1 to 10°C. per hour. An English installation, in which optical glass is annealed also, consists of two perpendicular



ELECTRICAL FILTER FOR TAR REMOVAL
(Osram Works)

tunnel ovens, which permit continuous operation. In both cases, the uniformity of temperature is aided by the high thermal capacity of the oven and the charging boxes.

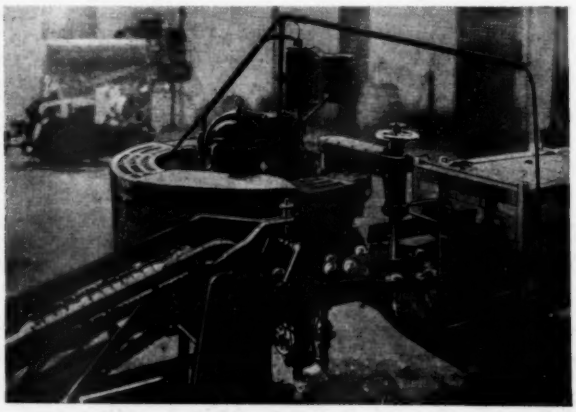
As an example of a tunnel oven with horizontal conveying, there was described an experimental annealing oven 15 meters in length, in which special material is to be cooled uniformly.

LOWER PART OF GAS PRODUCERS, SCRUBBERS, COMPRESSED AIR AND TAR REMOVAL
(Osram Works)

The temperatures here are considerably higher than in the glass cooling ovens. The oven channel is divided into three heating zones, each of which can be heated independently. The forward motion of the material takes place on fireclay plates, which are connected together to form a conveyor chain. The chain members themselves, are not exposed to the heat. The upper part of the fireclay plates is specially heated before entrance into the oven. For heating the entire oven to a high temperature on starting operations, an additional heat supply is necessary, as in continuous operation only a part of the heat loss must be replaced.

The largest installation with electric-heated glass cooling ovens for continuous operation is at the Illinois Pacific Glass Company, in San Francisco, where nine cooling furnaces for bottle glass are installed with belt conveyor, and each is 2.75 meters wide and 18 meters long. The current consumption during a rather long operating time was found to be about 90 kw. hr. per 1,000 kg. of bottle glass.

In general it may be said that the electrically heated oven has better heat insulation than an oven heated by fuel, because the electric heat is of much higher value than the heat of combustion in the heating gases. Mathematically, it is possible in many cases, for example, at Strakou, to increase the insulation in the cooling tunnel to such an extent that



EDGE REMELTING MACHINE, WITH AUTOMATIC FEED
(Osram Works)

supplementary heating is not necessary. One could not go so far in actual practice, and, in order to be able to adapt one's self to fluctuating operating conditions, a slight additional source of heat is provided.

In other cases, for example, in annealing ovens for optical glasses, the heat given up by the charge is not at all sufficient to maintain the temperature. In these cases, the insulation is developed as far as possible, and the necessary excess of heat is supplied by the heating source.

The question as to whether electric heating is to be recommended for a glass cooling oven, requires special investigation in every case. In general it can only be said that electric heating is to be preferred especially in cases where either cheap current (to about 3 pfennig per kilowatt hour) is available, or where the determining factor is advantageous operation, for example, higher quality of the material handled, lower rejection figure, greater simplicity of the installation and operation, etc.

X-Ray Methods of Investigation

By S. GOTTFRIED, BERLIN

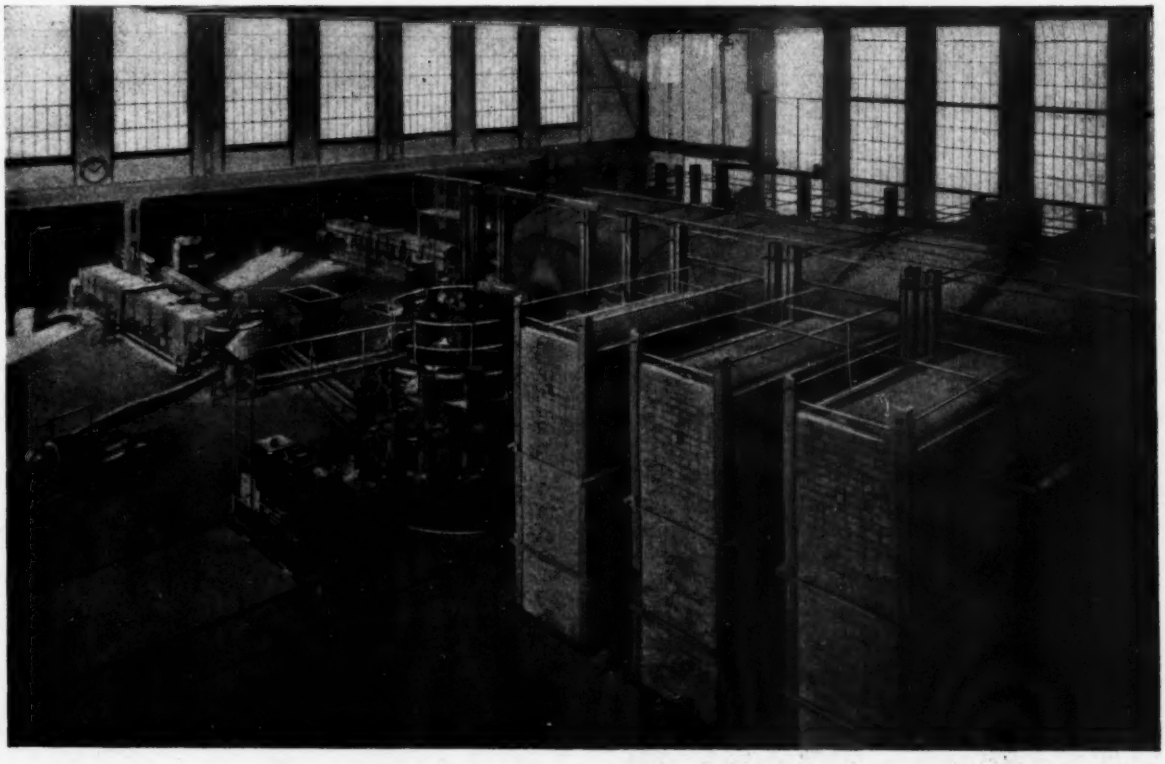
There are three X-ray methods of investigation:

1. The Laue method.

2. The Debye-Scherrer method.
3. The turning crystal method.

The Laue method consists in passing white X-ray light, as is present in damped spectra, that is, X-ray light of different wave lengths, through a crystal in a certain direction oriented crystallographically. On a photographic plate placed behind the crystal, the X-rays reflected from the most varied lattice planes of the penetrated crystal, produce black spots. The reflection of the X-ray light at the individual lattice planes takes place only when the equation $n\lambda = 2d \sin \delta$ is fulfilled. In this equation λ is the wave length of the reflected light, d the lattice plane interval, and δ the so-called reflecting angle, that is, the angle between incident ray and the lattice plane in question. Therefore, reflection takes place only with an absolutely determined position of the individual lattice planes to the incident ray. The Laue method has the advantage that from the reflected picture on the photographic plate one may draw a conclusion as to the symmetry of the irradiated crystal in the direction of the radiation.

In contrast with the Laue method, the second and third methods use monochromatic X-ray light, that is, light of only one wave length. While in the rotating crystal method well developed crystals must be available, the advantage of the Debye-Scherrer method lies in the fact that here one can use crystal powder. The powder to be studied is pressed into the form of a small rod or filled in a thin-walled glass capillary, and is subjected to X-ray light. On a photographic plate placed behind the preparation, or on a film placed cylindrically about the preparation, the interferences are recorded. The powder preparation, however, consists of unarranged accumulations of crystals which have all possible positions. On turning the preparation, some lattice planes—assuming sufficient fineness of the powder—always are in a position capable of reflecting, that is, the condition $n\lambda = 2d \sin \delta$ is fulfilled. On the photographic plate the totality of the reflections appear as interference circles concentric to the primary spot, while the interference bands on the film in general trace a conical shell and a cylindrical surface; only the interference rays deflected less than 90° appear as straight lines.



GENERAL VIEW OF TANK, WESTLAKE MACHINE, EDGE REMELTING MACHINERY AND LEHR
(Osram Works)

The essence of the third method, the rotating crystal method, consists in illuminating a well developed crystal in a certain crystallographically oriented direction, and the reflected rays are recorded on a crylindrical film whose axis is perpendicular to the incident ray. All interference points are arranged in a system of straight lines, of which one—called the equator—divides the entire picture into two symmetrical halves, while the others above and below are parallel to it at certain distances. By simple calculation from the magnitude of this distance, one can determine the magnitude of the indentity period on the turning axis in Angströms. By turning about the different axial directions, one obtains the length of edges and dimensions of the elementary body.

Composition of Modern Glass Mixtures

By Dr. Oskar Lecher[1]

Ruby Glasses

For the production of beautiful shining red colors, the so-called "Ruby glasses," gold ruby, selenium ruby, and copper ruby are used. Gold ruby may be made in tints ranging from delicate pink to deep purple, depending upon the amount of gold present, the red color produced showing a certain tinge of wine red. Deep, rich, blood-red shades are produced by the addition of copper, whilst selenium produces a shining cinnabar color. The manufacture of ruby glasses is comparatively difficult and used to be confined to a few glass works possessing special experience and working methods. These difficulties have gradually been eliminated, however, and most glass works should now be in the position to produce ruby glasses if certain precautions are observed.

The most beautiful lustre of gold ruby is obtained in lead crystal glass, which, indeed, is used in most cases. Since gold ruby is an expensive material, its lustre should not be spoiled by using it with ordinary cheap soda-lime glasses. The following list of compositions contains therefore mixtures of only two soda-lime glasses, the others being crystal glass mixtures exclusively.

The general success of the process as well as the intensity and shade of the coloration is largely dependent upon the care applied to the production of the gold chloride. Each glass works possesses its own recipes and its own process of manufacture. Some works buy the gold chloride from chemical works, while others produce it from pure gold in their own laboratories.

100 gr. of pure gold rolled out to thin sheets are dissolved in a heated mixture of 1,000 gr. of pure concentrated nitric acid and 1,400 gr. of pure concentrated hydrochloric acid. In another porcelain vessel, 100 gr. of pure granulated tin are similarly dissolved in a mixture of 1,000 gr. of concentrated nitric acid and 500 gr. concentrated hydrochloric acid. The solutions are concentrated on the water bath. No effort should be spared in using acids and metals of perfect purity, since but traces of foreign substances will seriously influence the tints of the products. The tin salts must be used in the freshest possible condition since its efficiency decreases very rapidly. If the material is obtained from chemical works, the contents of each flask should contain just enough salt for one charge. The amount of gold and tin salts required in each case is dissolved in water, 1:20, and the solution poured on the sand of the glass mixture. The salts must be absolutely free of hydrochloric acid in order to avoid decomposition of soda and potash of the mixture and the corresponding losses of alkali.

A very heavy Bohemian lead crystal is made of the following mixture:

		Corresponding to a composition of
100	best Hohenbocka sand	
191	minium	
8	98% potash	34.71% SiO_2
12	potassium nitrate	61.46% PbO
0.7	antimony	3.82% K_2O
25	pure gold } dissolved in acid.	9.01% Au
10	pure tin }	

Another very good mixture is the following:

		Corresponding to a composition of
100	sand	
80	minium	
12	potassium nitrate	41.53% SiO_2
11	potash	48.30% PbO
14	borax	10.17% K_2O
0.80	tin } dissolved in acid.	0.03% Au
0.02	pure gold }	
0.80	antimony oxide	

or :—

100	sand
125	minium
25	potash
16	potassium nitrate
0.08	pure gold, dissolved in acid
1	potassium tartrate

or :—

100	sand
82	minium
10	potassium nitrate
25	potash
0.025	pure gold } dissolved in acid.
1	tin }
2	antimony

or :—

100	sand
16	minium
32	borax
10	potassium nitrate
20	potash
1	arsenic
0.06	pure gold } dissolved in acid.
0.50	tin }
0.90	potassium tartrate.

Finally two mixtures free of lead are given:

1.	100	sand
	19	borax
	1	potassium nitrate
	32	potash
	0.60	potassium tartrate
	0.07	pure gold } dissolved in acid.
	0.10	pure tin }
2.	100	sand
	27	potash
	1	potassium nitrate
	0.5	arsenic
	6	of soda
	13	lime
	0.06	pure gold } dissolved in acid.
	1	tin }
	1	potassium tartrate

Since the gold salt contains about 48—55 per cent of metallic gold and the tin salt contains about 50 per cent of metallic tin, twice the amount given above must actually be added to the mixtures.

A mixture very rich in gold and lead, and very deep in color, which is much used for flashing coat and also for coloring opal glasses, as well as for the production of marbled glasses, etc., is the following:

[1] In *Continental Metallurgical and Chemical Engineering.* An article "Modern Glass Mixtures" by the same author appeared in the December, 1927, issue of THE GLASS INDUSTRY.

100	sand	
120	minium	
30	potash	
8	potasium nitrate	
4	borax	
0.10	pure gold	} dissolved in acid.
2	tin	}
1.2	potasium tartrate	

For flashed glasses, soft mixtures rich in lead are used. The color of the glass is not always darkened by increased additions of gold. The rich tint of gold ruby is produced only after repeated tarnishing and by liberal use of reducing agents, as, for instance, tin salt, antimony, and potassium tartrate. Differing tints may be produced, first, by the addition of varying amounts of gold salt, second, by adding small amounts of pyrolusite (wine red-violet), third, by combination with opal glasses, and, fourth, with selenium ruby containing or not containing cadmium sulphide. Variations of the composition of the glass mixture, on the other hand, will hardly influence the tints whilst possessing considerable influence upon the lustre, luminosity, and resonance of the glasses.

Glasses rich in lead should be melted in covered melting pots. If poor in lead, glass may be treated in open pots. Purest tints are obtained if the pots are closed. Best results are achieved with melting pots holding not more than 150 kg. of mixture. At some glassworks, particularly in Bohemia, very small pots of 20 to 50 kg. capacity are being used.

Melting temperatures are comparatively high and should be maintained as long as possible in order to assure perfect mixing of the gold with the glass flux. As a rule, the melting period amounts to 10—12 hours. If the melting temperatures are too low, a liver-brown glass results; remelting at higher temperatures will eliminate this defect. The finished melted glass should be blown repeatedly in order to avoid the formation of cords, etc. The finished glass may exhibit a number of colors, ranging from light yellow to reddish brown. The deep red tints must usually be produced by heat treating the glassware. The material is brought to red heat slowly and cooled off more rapidly. Glasses rich in gold respond more rapidly to this treatment, whilst glasses poor in gold may often have to be retreated several times. Glasses poor in alkali and rich in lead respond more readily to heat treatment, while alkaline lime glasses react but slowly. Gold ruby glass is very resistant to the reducing and oxidizing influences of the furnace gases. It is much better suited for flashed glasses and glassblowing purposes than copper ruby glasses.

Copper Ruby

While the production of colored ruby glasses is somewhat more difficult than that of gold ruby, the finished product is considerably cheaper. In producing copper ruby glasses, the following important points have to be considered: The glass mixtures used must not be too hard, much better results being attained with soft mixtures containing lead. The amount of copper used should be limited. Experiments have shown that much less difficulty is encountered in the production of ruby glasses containing 0.2—0.8 per cent of cuprous oxide than in following old formulas providing for copper contents of 2—5 per cent or even 25 per cent Cu_2O. Perfect reduction of these large amounts of cuprous oxide is very difficult indeed, so that quite frequently blue copper oxide glasses are obtained. Solution of the cuprous oxide is materially improved by adding about 2 per cent of borax. Chemically pure cuprous oxide should be used only, together with liberal amounts of reducing agents such as stannous chloride, sodium tartrate, stannic oxide, etc. A slightly reducing furnace atmosphere should be maintained throughout. Melting must be effected at high temperatures, which should be kept up for a comparatively long time in order to assure of uniform absorption of cuprous oxide by the glass. In some cases, remelting of the glass and, eventually, addition of fresh amounts of reducing agents may prove to become necessary. Cooling off too quickly often produces light yellow to orange colored glasses, the ruby color being developed gradually by annealing.

MIXTURE I—HARD GLASS

		Analysis:	
Sand	100	SiO_2	77.21%
Lime	12	Al_2O_3	0.62%
Potash	31	Fe_2O_3	0.05%
Soda	2.7	CaO	5.20%
Borax	0.5	MgO	0.03%
Cuprous oxide or copper		Na_2O	1.24%
sulphite	150	K_2O	15.44%
Sodium sulphite	200	CuO	0.12%
Sodium tartrate	400	B_2O_3	0.24%

MIXTURE II—A SOFT GLASS FREE FROM LEAD, SUITABLE FOR FLASHING GLASSES

		Analysis:	
Sand	100	SiO_2	65.22%
Lime	30	Al_2O_3	0.64%
Soda 98%	35	Fe_2O_3	0.66%
Borax	9	CaO	11.05%
Stannic oxide	4	MgO	0.04%
Cuprous oxide	4	Na_2O	13.50%
Sodium tartrate	2	K_2O	1.31%
Potassium nitrate	4	CuO	2.62%
Iron oxide	1	SnO_2	2.60%
		B_2O_3	2.37%

MIXTURES III AND IV ARE OF SIMILAR COMPOSITION

	III	IV (garnet red)
Sand	100	100
Lime	15	14
Soda	33	12
Potash	..	20
Borax	3	8
Tin ashes	2	0.15
Cuprous oxide	1.5	0.3
Sodium tartrate	0.5	0.45
Potassium nitrate	..	3
Selenium	..	0.14

MIXTURE V IS RICH IN LEAD AND PARTICULARLY SUITED FOR FLASHED GLASSES

		Analysis:	
Sand	100	SiO_2	62.31%
Minium	25	PbO	14.94%
Potash	25	Fe_2O_3	0.16%
Borax	15	Al_2O_3	0.84%
Cuprous oxide	2.5	CaO	0.12%
Potassium nitrate	4	MgO	0.01%
Iron oxide	0.2	Na_2O	1.54%
Manganese dioxide	2.5	K_2O	11.23%
Stannic oxide	5	SnO_2	3.15%
		CuO	1.40%
		B_2O_3	3.09%
		MnO	1.25%

Ruby glasses represent colloidal solutions of the metals in the sulphite. Coarse crystallization of the metals will cause the production of opaque glasses and of clearly visible metallic particles.

Bohemian glass works produce copper ruby flashed glass by the following method: A charge of soft copper ruby glass rich in lead is melted in a glass pot and poured out into water. After drying, the fragments are returned to the pot where they are remelted, gradually turning red in part. Half-crystal glass melted in the same furnace is then removed with the blowing iron and dipped into the ruby glass pot. The glass which is not colored sufficiently red as yet, will turn uniformly dark red in the cooling furnace.

Glass works which do not possess sufficient experience in the manufacture of copper ruby glasses should first produce flashed glass exclusively, since it is quite difficult to produce uniformly colored copper ruby. For the first charge melted, the following procedure is recommended:

The mixture is melted in a new glass pot. After blowing strongly, a sample is taken which, after cooling off quickly, must be almost colorless, but which on reheating to softness inside working door will gradually turn dark red. If this is not the case, about 1 Kg. of fresh mixture is mixed with 30—40 gr. of stannic oxide and sodium tartrate, and added to the melt in the pot. After stirring and permitting to stand for a short time, a new sample is taken and this procedure continued until a good color has been obtained. Later on, less copper may be used in the charges while the total amount of reducing agents added the first time should always be maintained afterwards. By following this method and observing the rules given above, and making sure that the composition and quality of the raw materials is good, every glass works should be enabled to advantageously use the above mixtures in producing good quality copper ruby glasses of the types described above.

The Laboratory

By J. B. KRAK, Technical Editor

Analysis of Light-Diffusing Glasses

The complete analysis of light-diffusing glasses is one of the more difficult problems in analytical chemistry with which the glass technologist may be confronted. It should never be entrusted to a beginner. The experienced silicate chemist will find it an interesting test of ability to deal with a somewhat complex situation.

When a light-diffusing glass of unknown composition is submitted for analysis, it is highly advisable to first make a complete qualitative analysis. Failure to do so may complicate the task needlessly and render the results of uncertain value. The urgency of the need to make a qualitative study may be realized when it is considered that light-diffusing glasses are made with a large variety of substances, such as may be seen from the accompanying table of batches.

Batches for the Production of Light-Diffusing Glasses

	I	II	III	IV	V
Sand	100	100	100	100	100
Soda ash	49	37	22	25	17
Potash	—	—	—	—	3
Red lead	56	22	15½	16½	2
Fluorspar	—	—	6	—	12
Feldspar	120	—	—	—	22
Cryolite	—	—	—	5¼	6
Borax	—	6	2	2½	—
Sodium fluoride	7½	—	—	—	—
Sodium chloride	5	1½	5½	—	—
Calcium sulphate	—	2	—	1½	—
Strontium sulphate	1¼	—	—	—	—
Salt cake	—	1½	—	—	—
Glauber's salt (cryst.)	—	2	—	—	—
Alumina	22½	30	—	17¼	—
Aluminum hydroxide	—	—	18¼	—	—
Sodium nitrate	5	—	5½	9¼	—
Antimonious oxide	½	1¼	—	—	—
"Silex"	—	12	—	—	—
Arsenious oxide	—	3	—	—	—

I J. J. Miller, U. S. Pat. No. 1,245,487.
II J. O. Mears, U. S. Pat. No. 1,166,922.
III G. Macbeth, U. S. Pat. No. 1,097,600
IV H. A. Schnellbach U. S. Pat. No. 1,143,788.
V Schnurpfeil, Die Schmelzung, p. 135.

These examples, which could be multiplied almost indefinitely, show sufficiently the chaotic condition of this branch of glass chemistry.

EDITOR.

It is evident, therefore, that in addition to the usual constituents of simple glasses, light-diffusing glasses may contain the following elements: Aluminum, antimony, arsenic, barium, boron, chlorine, fluorine, strontium, magnesium, manganese, sulphur, phosphorus, tin, titanium, zinc, zirconium and others. If a qualitative examination shows the absence of phosphorus—except in traces—the course of analysis is much simpler than when glass contains considerable amounts of phosphates, such as is the case in opal glasses, containing bone ash, or other phosphates.

The majority of modern light-diffusing glasses are of a semi-opaque nature, the tendency being to produce glasses that are translucent to a high degree without showing "fire." This effect is best obtained by using cryolite and feldspar, which, of course, must be quite free from iron. A mixture of cryolite, fluorspar and feldspar is preferred in many cases. In addition, red lead and zinc oxide are used; sometimes also borax. In the absence of the latter element, the analysis of semi-translucent glass calls for the determination of the following substances: Silica, fluorine, iron oxide,[1] alumina, lead oxide, lime, magnesia, titania[1], sodium oxide, potassium oxide, and zinc oxide.

There are, of course, several ways open to the analyst to determine the above mentioned substances. The choice depends on the preference of the individual. In the following outline, silica and fluorine are determined in one portion of the sample, sodium and potassium in another and the remaining elements in a third portion.

[1] Iron and titanium are usually introduced with the feldspar and the sand, as impurities.

The chemist will find considerable help in consulting Bulletin 700 of the United States Geological Survey by W. F. Hillebrand and "Standard Methods of Chemical Analysis," by W. W. Scott, Fourth Edition.

1. Silica and Fluorine, Berzelius' Method

Fuse one gram of the finely powdered glass sample with 5 gr. of sodium carbonate, extract with water and filter. To the aqueous extract containing fluorine and much silica, besides other elements, add several grams of ammonium carbonate and digest at a gentle heat for some time. Add more carbonate on cooling. Filter and wash with water containing ammonium carbonate. Evaporate to a small volume, add dilute hydrochloric acid until the carbonate is neutralized, using phenolphthalein indicator. Boil and discharge the red color again with dilute acid. Repeat until finally the addition of 1 or 2 cc of 2NHCl is sufficient to discharge the color. Five cc of ammoniacal zinc oxide solution (moist ZnO in NH_4OH) is added and the mixture boiled until ammonia has been expelled. This treatment removes the last traces of silica from the solution, which contains all of the fluorine as sodium fluoride.

The precipitates are combined, treated with hydrochloric acid and the silica determined in the usual manner. (Bull. 700 USGS. pp. 89-106; Scott, p. 444).

FLUORINE. To the solution add one cc 2N sodium carbonate solution, boil with an excess of calcium chloride solution and filter the precipitate consisting of a mixture of calcium fluoride and calcium carbonate. Wash with hot water, dry and ignite separately from the filter as far as possible. Transfer to a platinum dish, add some water and evaporate to dryness then add the ash of the filter. Heat the dish over a free flame for a few minutes to faint redness.

Pour dilute acetic acid over the mixture in small amounts at a time, in slight excess of that needed to dissolve the calcium carbonate. Evaporate to dryness, take up with hot water and a drop of acetic acid, filter and ignite gently. Weigh as CaF_2. $CaF_2 \times 48.68 = \%$ F.

2. Sodium and Potassium Oxides, J. Lawrence Smith Method

The alkalies are determined by the above method, using platinic chloride solution for the separation of potassium from sodium. (For details, consult THIS JOURNAL, Vol. 8, No. 4, p. 93, April, 1927). Instead of using the platinic chloride method, the proportions of sodium oxide and potassium oxide can be determined by precipitation of the sulphate radicle with barium chloride, weighing the $BaSO_4$ and calculating Na_2O and K_2O. (Scott, pp. 410-413; Bull. 700 USGS. pp. 207-215.)

3. Determination of Lead, Aluminum, Iron, Titanium, Calcium, Magnesium and Zinc

Decompose a one gram sample in a platinum dish with hydrofluoric and nitric acids. Take down almost to dryness, add nitric acid and repeat the evaporation and addition of nitric acid until the fluorine is removed.

LEAD. Electrolyze the solution, containing from 15 to 20 per cent of concentrated nitric acid, with a current of N. $D._{100} = 10$ amperes and 4.5 volts. The lead is deposited on the anode as lead dioxide. The precipitation is rapid, owing to the high atomic weight of lead and the small tension of PbO_2 in nitric acid. With a cylindrical gauze anode, ¾-inch in diameter and 2½ inches high, deposition will be complete in about 15 minutes. It is best to electrolize in a hot solution. $Pb.O_2 \times 93.31 = \%$ PbO. (Scott p. 275b.)

Lead may also be determined by treatment of the solution with hydrogen sulphide and conversion of lead sulphide to lead sulphate by dissolving in concentrated nitric acid and addition of sulphuric acid, using alcohol to render the lead sulphate insoluble. $PbSO_4 \times 73.59 = \%$ PbO. (Scott p. 274).

If lead is removed from solution with hydrogen sulphide, add bromine water to oxidize the metals and remove the excess by boiling.

ALUMINUM, IRON AND TITANIUM. This group is removed by addition of ammonia in some excess. The precipitate is filtered and redissolved in hydrochloric acid. The solution containing calcium, magnesium and zinc is reserved for further separation of these elements.

IRON AND TITANIUM. To the hydrochloric acid solution add 5 cc of sulphuric acid, cool to room temperature and add an excess of a 6 per cent solution of cupferron.[2] Filter and reserve the filtrate for the determination of aluminum.

Ignite the precipitate, containing iron and titanium at a low temperature. Weigh as $Fe_2O_3 + TiO_2$. Fuse with sodium pyrosulphate and determine the TiO_2 colorimetrically by addition of hydrogen peroxide and comparison of the depth of the color with that produced with a standard solution of titanium. Deduct the TiO_2 from the weight of the combined oxides. The difference is the Fe_2O_3. (Bull. 700 USGS. pp. 154-167; Scott pp. 545-547. For cupferron precipitation of iron see Scott p. 250)

ALUMINUM. To the filtrate from the cupferron precipitation add nitric acid and boil down to fumes of sulphur trioxide. Add a few drops of nitric acid to remove the last traces of organic matter, add water and some hydrochloric acid. Boil and add a few drops of methyl red indicator. Add a slight excess of ammonia, filter, ignite at 1,000 degrees C. and weigh as Al_2O_3.

CALCIUM. To the filtrate of the ammonia precipitation add oxalic acid, filter the calcium oxalate and determine CaO either gravimetrically by ignition at a high temperature or volumetrically with N/10 permanganate solution. (1 cc = .0028 CaO)

MAGNESIUM. To the filtrate of the lime, add di-ammonium phosphate and an excess of ammonia and stir vigorously. Filter the precipitate of magnesium ammonium phosphate and ignite to magnesium pyrophosphate. $Mg_2P_2O_7 \times 36.20 = \%$ MgO.

ZINC. Boil the filtrate to remove the excess of ammonia. Add formic acid and gas with hydrogen sulphide, which precipitates the zinc as zinc sulphide. It is allowed to settle for a few hours at a moderately warm place, filtered and washed with water containing some hydrogen sulphide. Calcine in a porcelain crucible and weigh as ZnO.

---

[2] Cupferron, Amino nitrosophenylhydroxylamine, also known as Baudisch's reagent, is made by dissolving 6 grams of the salt in water and diluting to 100 cc. The reagent should be kept in the dark, as light slowly decomposes it, forming nitrobenzene.

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CONTRIBUTIONS

THE EDITOR welcomes practical articles on all subjects related to GLASS MANUFACTURING. Such articles, if accepted, will be paid for at our usual rates.

We heartily wish All of Our Readers
A Happy and Prosperous New Year

Vol. 9 JANUARY, 1928 No. 1

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1927 A Year of Technical Progress

Since the first issue of this journal it has been our privilege to record vast improvements in processes of glass manufacturing. But to few, if any years of the past, can be given credit for the number and significance of advances that have occurred in the twelve months just passed.

In every case progress has not come as a stroke of good fortune, but as the final reward of long periods of careful research and patient experimentation, that have come to fruition. The lines in which improvements have been attained are varied; they include machinery, processes, refractory materials, and modifications of the final product itself, showing that research work is no longer concentrated on one or a few phases, but comprises every field connected with glass manufacturing.

Great improvements have been made in annealing. Not less than three types of new lehrs have appeared on the equipment market. While each kind has its own special advantages, they are all characterized by low fuel consumption, decreased annealing time and perfection of product. These lehrs are the result of a better understanding of the scientific principles of annealing, which have first been studied, then formulated and subsequently put into practice.

The discovery of making cast tank blocks in the electric furnace has resulted in the organization of a concern that will make available to the glass industry a refractory block of superior heat resisting qualities. A number of makers of glasshouse refractories have begun to make use of the studies of refractory materials, made in research laboratories and workshops. The prospects of a satisfactory solution of the refractories problem are brighter than ever before.

A great advance was recorded in the new method of manufacturing plate glass, using the principle of the rolling mill and resulting in the production of more finished glass per pound of batch used than has been obtained by any other method previously developed. The rights covering the use of this new process have been bought by one of the leading plate glass manufacturing concerns on this continent.

No recent discovery in glass has had a wider appeal than the successful solution of the problem to manufacture ultraviolet transmitting glasses. The use of ultraviolet rays in medicine and in sanitation has attracted the attention of large numbers outside of the medical fraternity. But the fact that these health-giving rays can be allowed to enter into our homes, offices, schools and factories has made the subject one of almost universal appeal. A number of glass manufacturing firms have put ultraviolet transmitting glasses on the market, and it is hoped that further progress, resulting in lower prices and improved quality will bring this new product within the reach of a large part of the population.

In the field of illuminating glassware the development of a method of inside frosting of glass electric light bulbs is noteworthy. The pressed glass industry can look forward towards a satisfactory solution of the troublesome mold problem, through advances in methods of chromium plating.

While the year just closed has not been one of general prosperity to the glass industry as a whole, it has been fruitful from a technical standpoint.

Technical Consultation Service

Limestone, Burnt Lime or Hydrated Lime[1]

QUESTION 112: For some time I have been endeavoring to persuade my company to use a high grade limestone in the stead of hydrated lime for our batch mixtures. The lime is much higher in price than the limespar and a substantial saving could be made if the change were effected. However, objection is made on the ground that in the manufacture of machine-made bottles we do not find limespar being used in this country. Can you furnish me with any information as to companies that are using limespar in their batch mixtures?

ANSWER: Little is known as to the differences that may occur when burnt lime, hydrated lime and limestone are interchanged It is a fact borne out by experience, that bottle glass batches containing burnt lime melt quicker and give a more fluid glass at corresponding temperatures than when limestone is used. However, the great difference in cost would suggest the use of limestone in the majority of cases. It is felt, therefore, that in our opinion you are perfectly justified in urging the use of high grade limespar instead of hydrated lime or burnt lime.

There are about as many factories favoring the use of burnt lime or hydrated lime as there are who prefer limestone. In order to find out more about this important question, we have made inquiries among a number of glass technologists, active in the bottle glass industry, and are hereby giving their replies:

1. Limestone preferred. Reason: Cheaper, when of as good quality as burnt lime.
2. Limestone preferred. Reason: Lower cost, easier to handle.
3. Limestone preferred. Reason: Lower cost, otherwise burnt lime is as good.
4. Burnt lime preferred. Reason: A more uniform product can be made from materials which in themselves are uniform.
5. Either burnt lime or limestone. Reason: My experience has not been positive with respect to raw limestone or burnt lime; both seem about the same. The high prices of hydrated lime is not justified by results.
6. Either burnt lime or hydrated lime. It depends on the kind of glassware made. For cheap flint bottles burnt lime is to be preferred. For high grade flint bottles would take hydrated lime. Hydrated lime would be best for tank flint, if available at a low price, but the high cost makes it prohibitive.
7. If we were to manufacture window glass or colored bottle glass and had a large furnace, we would prefer limestone, for it is easy to handle, cheap in price and is a good boiler.

   If we were to manufacture flint bottles or cheap table ware, we would prefer burnt lime because the producers are more careful in selecting their lime, and when the rock is burnt they are able to pick out the discolored chunks that run high in iron. Thus the manufacturer is able to secure a good product, and the result is he is able to decolorize his glass much easier and maintain a good color.

   Raw lime often contains organic matter, and this has a detrimental effect on selenium, which is used as a decolorizer.

   In the manufacture of high grade flint glass, I would prefer hydrated lime because it runs more uniform in strength than burnt lime. Burnt lime takes on moisture, and for that reason its strength varies. Hydrated lime would be ideal for tank flint, provided it could be purchased at a low price, but additional cost, together with the extra quantity that has to be used, makes its use prohibitive in the bottle industry. If hydrated lime could be purchased at a low price it would be the most ideal lime that could be used, regardless of whether you manufactured window glass, cheap flint glass or high grade flint glass.
8. Burnt lime preferred. Reason: Because we can pull our tanks harder.
9. Limestone preferred. Reason: Uniformity of composition and lack of variation when exposed during storage. Stirring action of carbon dioxide, evolved during melting of batch.

[1] We invite the views and comments of our readers on this subject.—[EDITOR]

Prof. Turner Discusses Modern Artistic Glass

Meetings of the Society of Glass Technology at Stourbridge, England, were held on November 22 and 24 ,1927. Prof. W. E. S. Turner gave a popular lecture on "Modern Artistic Glass."

After referring to the properties which glass possessed as a medium for artistic expression, Professor Turner stated that the two requisites for permanence in art were (1) Beauty of form and (2) a knowledge of technique. With regard to form, this was exemplified in the high standards of later Egyptian, Roman and Venetian glass. Elegance survived in a few modern factories, but it was not general.

In the matter of decoration there was a wonderful field open to the glass craftsman. The question for the artist was how best to reconcile proposals for treatment with the natural properties of the glass. Thus, enamelling, or even casing, might be carried too far, if it obscured entirely the transparence or translucence of the glass. The brilliance of cutting should have relation to the nature of the subject. Deep breaking or cutting of the surface might be bad artistically.

Professor Turner then went on to give a detailed study and review of artistic glassware in different countries. In America the man who had done most to develop artistic glass in the United States was an old friend of the Stourbridge neighborhood, Frederick Carder, who was regarded as America's master glass maker. References were next made to modern glass production in Belgium, Austria, Germany, Czechoslovakia, and Sweden, as well as to two British firms, Messrs. James Powell & Sons (Whitefriars), Ltd., and to Messrs. John Moncrieff, Ltd., Perth (*Monart* ware). With regard to France developments there had come through strength of personality, the most notable personalities of the last 50 years being Rousseau, E. Galle, Laligue, G. Despret, and M. Marinot. In no country had there been so marked a departure from the orthodox in form and decoration as in France.

The chairman, Mr. Walter Butterworth, Sr., M.A., (President of the Society), commented on Professor Turner's remarks so felicitously that he was invited to give a lecture himself to deal more particularly with stained glass.

A paper, "Stourbridge Fireclays and the Manufacture of Glass House Pots," was presented by M. H. Edwards.

"Glass-Pot Manufacture in Great Britain" was presented by Prof. W. E. S. Turner.

Six lengthy tables, giving the results of a survey of the conditions of pot making in this country were presented. These tables were: (1) General particulars concerning the pots. (2) The clay and its preparation. (3) The drying and storage of pots. (4) The treatment of pots in the arch. (5) Conditions of pot use in relation to life. (6) Life of pots.

The lecturer discussed the mass of details given in each table, the information for which was obtained as the result of a questionnaire circulated to a number of representative firms in England and Scotland.

From a Correspondent

To the Editor of THE GLASS INDUSTRY:

We note in your September, 1927, issue the article entitled "The Bicheroux Process of Making Plate Glass." For your information, we are enclosing copies of the following patents owned by The Chemical Foundation:

Nos. 1,090,904, 1,101,392, 1,105,610, 1,114,098, 1,175,116, 1,175,117.

These patents [issued to Max Bicheroux and assigned to others] are available for license to any concern who can qualify under Paragraph 3 of our charter, copy of which is enclosed.

THE CHEMICAL FOUNDATION, INCORPORATED,
Wm. M. Buffum, General Manager.

New York, Dec. 6, 1927.

THE LIFE OF POTS which have been brought up in a pot furnace is usually greater than the average life of pots brought up in pot arches. However, the occasional loss of pots while being brought up in furnaces tends to cause manufacturers to heat the furnace empty, or only partly full of pots, and then fill in from the pot arches after the furnace has reached a dull red heat.

Breakage of pots nearly always occurs below a dull red heat. Frequently the cracks resemble drying cracks, indicating that the trouble is at the beginning of the heating, and may be prevented by avoiding rapid fluctuations of humidity and temperature at this stage.—*Pearson.*

Some Achievements of Hazel-Atlas

Interesting remarks outlining the history of one of our industry's leading "institutions"—the Hazel-Atlas Glass Company—were made recently by G. Wesley Evans, superintendent of the company's Grafton, W. Va., plant, during the course of an address to the members of the Kiwanis Club of that city. Part of his story, as reported in the Grafton *Sentinel*, follows:

"The Hazel-Atlas Glass Company, is, of course, a West Virginia corporation. Its beginning was very modest, when in 1886 Mr. C. N. Brady organized the Riverside Glass Co. of Wellsburg, W. Va., and became its president. He rented an old abandoned flour mill at Wellsburg, built two very small tanks and in a very small way began the manufacture of porcelain liners for fruit jar caps. A little later, the town of Washington, Pa., offered a factory site, and operations were moved to that place. The name of the concern was changed to the Hazel Glass Company, and Hazel No. 1 plant was erected and started, and there that plant now stands, though many times as large. In fact, that plant is now the largest producer of opal glassware in the world.

"In that plant the first continuous tank furnaces for the manufacture of small bottles continuously day and night without interruption were installed and developed along with improved machinery, increasing production and reducing cost. The capacity of Hazel No. 1 plant was soon outgrown and a new and larger factory was built where No. 2 plant now stands in Washington.

"Soon Mr. C. N. Brady and others became interested in the fruit jar game. A separate company was formed and called the Atlas Fruit Jar Company. A plant was erected and the first machine made fruit jars were produced. This factory is our present Atlas factory in Washington, Pa.

"In 1896 Mr. W. S. Brady, a brother to Mr. C. N., who had been for years secretary and manager of the Fostoria Glass Company at Moundsville, organized a new company for the production of tumblers and jelly glasses by machine methods which had never been successfully accomplished prior to that time. They called themselves The Republic Glass Company, and because of the cheap gas available located at Clarksburg, W. Va., with one small furnace and five machines. That was the beginning of our present largest pressed ware plant in the world at Clarksburg.

"All the glass manufactured at the Hazel plants, Atlas and Republic plants required metal caps and closures. To assure a continued supply of these trimmings at a reasonable cost the Wheeling Metal Company was organized and began our now huge metal plant at Wheeling.

"During 1901-02 the consolidation was arranged of the Hazel Glass Company, the Atlas Fruit Jar Company, The Republic Glass Company and the Wheeling Metal Company, into our present Hazel-Atlas Glass Company, with capital stock of one million dollars. Just here I might say that the present capitalization is $15,000,000 and shares of $25 par are quoted on the Wheeling market at $70. Try and get some of them!

"In 1909, Hazel-Atlas acquired an exclusive right to manufacture without royalty, by Owens Machine a general line of packers' ware. In 1914, eleven complete Owens units were installed at Hazel Factory No. 2 at Washington, three more were put on a new tank at Clarksburg, and in 1916 the Grafton plant was built with two tanks and six Owens units.

"The Kearns-Gorsuch Bottle Company with plants at Zanesville and Barnesville was purchased in 1920. Soon afterward the Barnesville plant burned down. Then the present Zanesville No. 2 plant was built which now has three tanks manufacturing narrow-necked bottles, jugs, thin blown tumblers, etc. The Zanesville No. 1 plant produces novelty stuff such as our friend Pat handles.

"We at present comprise:

"Hazel No. 1 plant, 7 tanks, Washington, Pa.

"Hazel No. 2 plant, 4 tanks, Washington, Pa.

"Atlas plant, 4 tanks, Washington, Pa.

"Clarksburg plant, 5 tanks, Clarksburg, W. Va.

"Grafton plant, 2 tanks, Grafton, W. Va.

"Oklahoma plant, 1 tank, Blackwell, Okla.

"Zanesville No. 1 plant, 2 tanks, Zanesville, O.

"Zanesville No. 2 plant, 3 tanks, Zanesville, O.

"Wheeling Metal Plant—caps, bands, etc., Wheeling, W. Va.

"Sand Plant at Great Cacapon, W. Va.

"Clarksburg Gas & Coal Co., Clarksburg, W. Va.

"Comet Oil Gas Co., Grafton, W. Va.

"In 1905, Hazel-Atlas produced the then remarkable total of 918,213 gross of good glassware. Our production has steadily increased until now it is right at 10,000,000 gross annually, which means well over a billion pieces of glassware. Our metal plant produces over 2,000,000 gross of caps yearly besides manufacturing vacuumizers and machines for filling and capping jars.

"C. N. Brady was president until 1909, W. S. Brady until 1919, and then Mr. J. C. Brady until 1925, when Mr. J. H. McNash became president.

"There is no such person as a glass blower in our organization. Every operation involved in the actual forming of the glass articles is done by machinery. We operate entirely on the open-shop plan—always have and always will! The payroll embraces about 4,000 persons and totals over $6,000,000 (6 million) annually exclusive of salaries. There is no better organization to work for anywhere—ask some of the mold makers who are now out on strike.

"We and you who are so familiar with glass may never have thought of it as mysterious—incomparable—playing a leading—a vital part in the onward march of civilization.

"Without glass we would still be in the cave and tent period of living; we would rove the seas only as the wind carried us and move from place to place as the need for food and water impelled us—only by foot, horse or camel. Nomads we would still be.

"Without glass our conception of a higher power would be bound by superstition, because the stars out in illimitable space, the sweeping comets, the grand master of the day—the sun, and the sweet mistress of the night, the moon, would be but mysteries. Every step toward and every move forward has been possible only because of the aid that glass has given.

"Man began to progress when the secrets of nature began to unfold. The alchemists and then the chemists, aided by glass—the essential, the incomparable—delved into and learned secrets of Nature, out of which came iron and the various alloys of metals so important to us today. Then came the physicists, the mathematicians and all branches of science, each with glass as the irreplacable handmaiden.

"With the glass miscroscope they are looking into and solving the secrets of the atom. With the glass prism they are catching the light from far away planets and dissecting it, thereby learning of gases and compounds that man heretofore knew not of and applying the knowledge gained to the benefit of mankind. They are taking glass and enclosing in it the electric spark and projecting the voice of man and his music around the world through the medium of the radio. With the telescope made of glass they are looking out into the universe, out into endless space and finding there worlds not before dreamed of."

Mr. Evans gave further illustrations of the part that glass, made from common materials, is playing in the solution of intricate problems of civilization, and pointed out that without glass many of the most and useful discoveries of science would never have been made.

At the same meeting Robert Knotts, assistant superintendent of the factory, stressed in detail the making of glass, and the huge amount of raw material that is used weekly by Grafton factory.

He said that 10 cars of sand, 3½ cars of soda ash and 1½ cars of lime are used weekly. The sand is obtained from Berkeley Springs, the soda ash from Painesville, Ohio, and the lime from Martinsburg.

Brooks Gall explained how an order is taken care of in the plant, tracing such an order from the time it is received by one of the 26 salesmen of the company until the goods are in the hands of the purchaser.

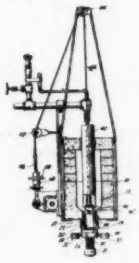
Three hundred persons—250 men and 50 women—are employed in the Grafton plant, Mr. Gall declared, and last year 83,600,000 pieces were shipped from this plant. This year, according to Mr. Gall's belief, business will be 25 per cent better. Already the record shipment of 50 cars in one week was made in August, he said, and improved business conditions this fall will tend to increase the output.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

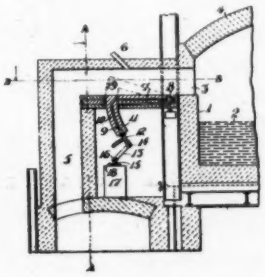
Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

FLOW FEED FOR GLASS MACHINES. U. S. 1,648,435. Nov 8, 1927. Samuel E. Winder, Chicago, Ill., and Henry C. Daubenspeck, Massillon, O. Filed 7/23/24. An object is to provide a machine, of the class described, that is particularly adapted to spin the upper or rim portion of glass tumblers in an inwardly direction, for the purpose of cupping the same, comprising a vertically movable rotatable forming tool, a vertically movable member co-operating therewith adapted to support a plastic article and to lower the same within the path of movement of said forming tool and means for synchronizing the vertical movements of said forming tool and said supporting member with respect to each other.



HEATING MEANS FOR SHEET-GLASS APPARATUS. U. S. 1,649,031. Nov. 15, 1927. John N. Henderson, New York, assignor to the Libbey-Owens Sheet Glass Co. Filed 1/13/27. Means for drawing a sheet vertically from a mass of molten glass, means for deflecting said sheet from the vertical into the horizontal plane, and means for passing an electrical current vertically through said sheet during its vertical run to heat the same prior to the deflecting thereof.

REGENERATIVE FURNACE. U. S. 1,648,191. Nov. 8, 1927. Robert D. Pike, San Francisco, Cal., assignor to Cole-French Co. Filed 10/11/22. In a regenerative furnace, a combustion and exhaust port leading to the furnace and a pivotally mounted damper in said port having an angular portion at its front end, said damper being movable to leave the port area larger for exhaust purposes than for combustion purposes and to form a passageway of gradually expanding cross-section for combustion purposes. It is claimed that this invention may be easily applied to glass tank furnaces as at present constructed with very little change in construction.



REENFORCED GLASS. U. S. 1,646,097. Oct. 18, 1927. Michael Liptak, St. Paul, Minn. Filed 2/28/27. A section of transparent material [as glass] having strips of reenforcing material embedded therein, the strips being spaced to provide an unreenforced clear vision area.

GLASS-CUTTING APPARATUS. U. S. 1,650,345. Nov. 22, 1927. James B. Greer, Pittsburgh, Pa., assignor to the Greer Manufacturing Co. Filed 8/6/25. One object is to provide a glass cutting machine which shall include design-cutting mechanism and banding mechanism in a single self-contained unit and to provide means for operating the design-cutting and band-cutting mechanisms in suitable succession, the banding mechanism being automatically operable upon completion of the design-cutting mechanism. The general features of the machine include a chuck carried upon an inclined chuck shaft and rotated intermittently by means of a novel arrangement of intermittent gears; pivoted frames carrying the cutting wheels and rocked simultaneously upon their pivots so as to move the cutting wheels toward and away from the chuck; a compensating device associated with the chuck and the grinding wheels; a throwout device for stopping the action of the grinding wheels after the design has been completed; and a banding device, so arranged as to rotate the chuck continuously after the first design has been completed, and to apply to the surface of the glass one or more banding wheels which operate to cut circular bands upon the ware in accurate registry with the design applied to the glass by means of the cutting wheels.

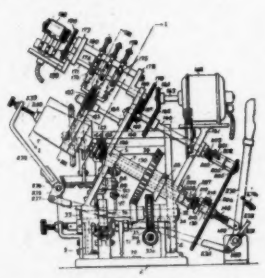
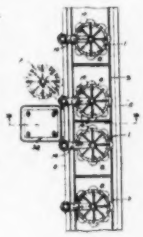


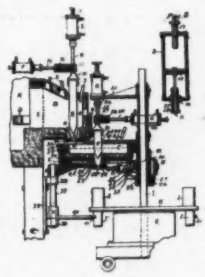
PLATE-GLASS-SURFACING APPARATUS. U. S. 1,651,224. Nov. 29, 1927. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 6/16/23. When it is desired to wash the felts of a runner frame, it is first raised from the table by means of a plunger, then swung laterally to the side of the table to the position marked A. After it is moved to this position, the car is moved beneath it and the felts are washed. This may be accomplished in various ways as by the use of hand scrapers and the application of water jets to the felts, or the felts may be lowered into the pan of water and rotated, suitable scraping means being carried by the bottom of the pan.



METHOD AND APPARATUS FOR MAKING GLASS TUBING. U. S. 1,653,848. Dec. 27, 1927. Sidney S. Grotta, Hartford, Conn., assignor to Hartford-Empire Co. Filed 3/21/25. The method of forming glass tubing, which comprises passing molten glass from a supply body in an annular stream of substantially uniform diameter, then passing glass from the outer end of said stream in an outwardly enlarging frusto-conical stream, cooling said frusto-conical stream externally, finally passing glass from the larger end of the frusto-conical stream in the form of a tube of substantially uniform diameter, and introducing cooling fluid into said tube.

PLATE GLASS MANUFACTURE. U. S. 1,654,198. Dec. 27, 1928. Frank S. Whitlock, Rossford, O., assignor by mesne assignments, to Commercial Savings Bank & Trust Co. Filed 3/29/26. The method of forming glass sheets comprising forming a gob of greater extent horizontally than vertically, and catching said gob in its descent to increase its vertical extent both upward and downwardly from the point of catching.

APPARATUS FOR FEEDING GLASS. U. S. 1,651,036. Nov. 29, 1927. William J. Miller, Swissvale, Pa., assignor to Hartford-Empire Co. Filed 8/15/22. One of the objects in view is the mixing or stirring of the glass in the feeding receptacle so that the glass discharged therefrom will be perfectly homogeneous in temperature and quality, so that, not only will each mold charge be homogeneous throughout, but homogeneity in a succession of mold charges will be obtained. For this purpose such movement is imparted to the feeding receptacle to which the glass is delivered from the tank that the different strata or laminæ are so intermingled at the discharge orifice so that the glass discharged from said orifice maintains the desired homogeneity.

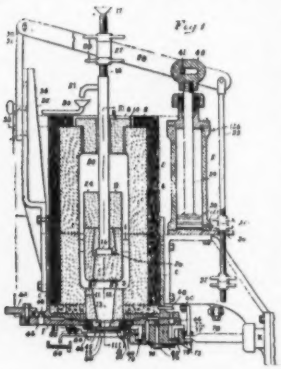


GLASS-CUTTING MACHINE. U. S. 1,650,375. John A. Milliken, Egg Harbor City, N. J., assignor to John E. Marsden, Philadelphia, Pa. Filed 9/11/25. Glass cutting apparatus comprising a work holder, a grinding wheel biased into engagement with an article on said chuck, means for intermittently withdrawing said wheel from the article, means for rendering said means ineffective

whereupon the wheel is biased into engagement with said article, means for non-intermittently rotating said chuck a distance greater than one revolution thereof, and means for temporarily withdrawing said wheel from the article.

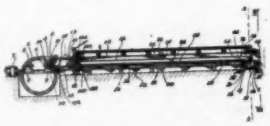
APPARATUS FOR PRODUCING A SILVER COATING ON GLASS. U. S. 1,648,504. Nov. 8, 1927. Luitpold Offenbacher, Furth, Germany, assignor to Bayerische Spiegelglasfabriken Bechmann-Kupfer. Filed 9/12/24. An apparatus for silver coating sheets or plates of glass comprising in combination an oval track, a heated drying chamber in the shape of a tunnel on said track, a transportable frame, wheels on said frame, a table on said frame, means for producing a see-saw motion of said table, a rubber tub on said table designed to receive a silver solution and the sheets or plates of glass to be coated, and means for propelling said transportable frame so that it runs on said track.

APPARATUS FOR PRODUCING MOLD CHARGES OF MOLTEN GLASS. U. S. 1,642,967. Sept. 20, 1927. William J. Miller, Swissvale, Pa. Assignor to Hartford-Empire Co. Filed 9/23/19. In combination with a container for molten glass provided with a discharge port, means coacting with said port for the discharge of glass therethrough at intervals, fluid pressure means for operating the latter, shearing means for severing gathers from the glass discharged from said port, fluid pressure means for operating said shearing means, a valve controlling the admission of power to said first named fluid pressure means, a second valve controlling the admission of power to said second named fluid pressure means, and means whereby the operation of one of said valves is timed by the operation of the other of said valves.



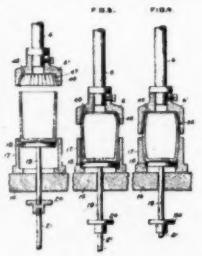
GLASS FURNACE. U. S. 1,641,898. Sept. 6, 1927. Joseph M. Neenan, Shreveport, La., assignor to the Libbey-Owens Sheet Glass Co. Filed 5/7/24. In a continuous tank-furnace for supplying molten glass to a glass-working machine, means for restricting the flow of the upper glass strata through the tank, comprising an internally water-cooled metallic partition member extending transversely across the tank and projecting down through the uppermost strata of the molten glass, and having a slot or passage for allowing the glass to flow therethrough, the slot being below the normal glass level and parallel therewith.

LEHR CONSTRUCTION. U. S. 1,638,769. Aug. 9, 1927. Halbert K Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 11/30/26. The lehr is designed so as to permit the sheets of glass to be carried through the front end of the lehr at a high rate of speed, and then through the following (and major) portion of the lehr at a speed which is only a fraction of the speed in the front end. The rolls are so arranged and timed that the forward end of the sheet which is being moved ahead of the high speed rolls comes closely adjacent to the rear end of the preceding sheet which is being moved forward by the low speed rolls before the rate of movement of the high speed rolls is reduced, which arrangement, as above stated, allows the use of the lehr to its full capacity.



CHANGING GLASS-FEEDER BUSHINGS. U. S. 1,642,881. Sept. 20, 1927. John Murl Lents, Evansville, Ind., Assignor to the Owens Bottle Co. Filed 10/12/25. Frequent removal of clay feeder bushings and replacement by new bushings is required in practice. The inventor claims the method of temporarily obstructing the flow of molten glass through a channel or passageway at a predetermined point and permitting the glass beyond said point to be withdrawn, which comprises placing a mechanical obstruction [water patch] across the path of the glass at said point, agitating said obstruction to prevent freezing of the obstruction to the walls of the channel, and removing from the channel the glass beyond said obstruction, permitting removal of the old bushing and installing a new one.

GLASS-FORMING MACHINE. U. S. 1,649,641. Nov. 15, 1927. George E. Zeiler, Pittsburgh, Pa. Filed 4/6/22. A machine for shaping glass receptacles while in a plastic state including a vertically movable rotable forming head, a receptacle adapted to contain a plastic article, a plunger for supporting said article within said receptacle and fluid pressure means for raising and lowering said forming head and plunger simultaneously at different speeds. It will be understood that a tapered tool may be employed which is adapted to engage the inner edge of the article to form a flared opening, as in the well known "soda" glass.

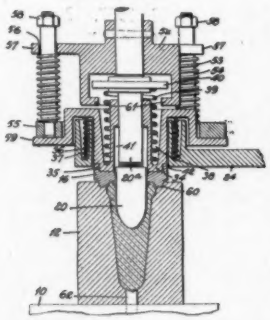


GLASS COMPOSITION. U. S. 1,615,247. Jan. 25, 1927. William Chittenden Taylor, Corning, N. Y., Assignor to Corning Glass Works. Filed 11/2/22. The inventor has discovered that the addition of certain salts, such as chlorides or bromides, to a non-lead glass of a relatively high silica content containing boric oxide, causes the otherwise transparent glass to become translucent as are the so-called opal glasses. This discovery therefore provides means for obtaining glasses of the last-named character without necessitating the use of fluorides, phosphates or alumina heretofore used for that purpose, although the desired result is not interfered with by the presence of the alumina or of other elements, such as lime, magnesia, zinc, lead, etc. The glass resulting from this invention is stated to be superior in many respects to the old fluoride or phosphate opals.

The following are examples of foundation glasses which have been successfully used:

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
SiO_2	71½	75	75	75	78	80	80	80	76	85	85	90
B_2O_3	22½	13	17	22	16	10	18	13½	12	10	7	3
Na_2O	6	12	8	3	6	10	2	4½	8	5	8	..
Al_2O_3	..	..	..	..	..	..	..	2	..	..	..	2
Li_2O	..	..	..	..	..	..	..	..	..	..	..	5
CaO	..	..	..	..	..	..	..	..	4	..	..	..

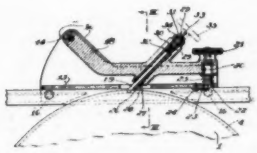
GLASSWARE-SHAPING MACHINE. U. S. 1,642,722. Sept. 20, 1927. John Davis, East Hartford, Conn., assignor to Hartford-Empire Co. Filed 9/25/25. The object is to provide a machine for producing pressed ware that shall be capable of producing ware of different sizes and shapes, thereby enabling the manufacturer to fill several small orders by the use of a single machine, and obviating the necessity of employing separate machines for each type of ware. This object is accomplished by providing each individual mold with its own neck ring and plunger which are combined in a movable structure adapted to be brought into operative relation with its co-operating mold at the pressing station and to be moved aside from the mold at the other operating stations.



METHOD AND APPARATUS FOR PRODUCING CHARGES OF MOLTEN GLASS. U. S. 1,642,904. Sept. 20, 1927. Leonard D. Soubier, Toledo, O., Assignor to the Owens Bottle Co. Filed 2/4/24. An object is to provide a practical means and method of varying the effective diameter of the outlet opening while the feeder is in operation. The inventor claims the combination of a container for molten glass having an outlet opening formed in the bottom

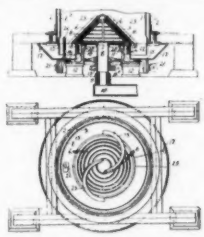
thereof, a vertically reciprocating plunger projecting downward into the glass in the container in alignment with said opening, and a sleeve surrounding said plunger and spaced therefrom, the lower end of said sleeve being of smaller external diameter than the diameter of the outlet opening and shaped to enter said opening and form therewith an annular passageway through which glass may be discharged.

MULTIPLE-GROOVE-DRESSING DEVICE FOR ABRASIVE WHEELS. U. S. 1,651,225. Nov. 29, 1927. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 3/18/26. A dressing device, comprising a frame releasably secured to the work guideway of a grooved abrading wheel, an arm pivoted to said frame for movement toward and from the wheel, an adjusting device for the arm, a plurality of dressing rods of abrasive material carried by the arm and adapted to engage the various grooves in the abrading wheel, each of said rods being mounted for rotation about its axis, and gear means for rotating the rods in unison.



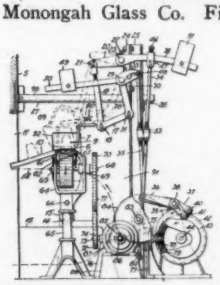
COMPOSITION FOR CLEANING AND POLISHING GLASS. U. S. 1,643,251. Sept. 20, 1927. George A. McBride, Seattle, Wash. Filed 8/11/26. The composition removes dirt, grease and other incrustations but also polishes the glass. Amyl acetate 0.84 per cent by weight, Ammonium carbonate .046, Mineral oil, such as kerosene 99.114.

GAS PRODUCER. U. S. 1,650,187. Nov. 22, 1927. William Climie, Mossend, Lanarkshire, England, Filed 6/15/22. A gas producer provided with an air blast cone consisting of a plurality of superimposed rings having slots or openings between same and of a double kneed formation. The said rings are secured to an angled frame fitted to a base plate adapted to rotate and provided with water seals. Projecting ribs are provided on the angled surface of the cone and a rotatable ash pan having a projecting knife is located below and around the cone. Centrally at the bottom end of the inner casing an air blast cone is arranged.



ZIRCONIA-FACED REFRACTORY. U. S. 1,650,577. Nov. 22, 1927. Paul G. Willetts, Berlin, Conn., assignor to Hartford-Empire Co. Filed 1/20/26. A refractory body having a facing of substantially pure zirconium oxide that is partially interpenetrated with said body and is therefore united integrally therewith, by dry-pressing to the backing material by an intermediate layer composed of zirconium oxide and the backing material.

APPARATUS FOR HANDLING GLASSWARE. U. S. 1,650,900. Nov. 29, 1927. Wilbur S. Mayers, Fairmont, W. Va., assignor to Monongah Glass Co. Filed 10/10/22. A lehr feeder comprising a moving ware carrier moving transversely of the lehr end, a pusher movable across the carrier toward and from the lehr, to remove successive series of ware from the carrier, and means for raising the pusher above the top of the ware when moving away from the lehr, the supporting connections for the pusher being at all times outside of the path of the ware advancing on the carrier. The device is claimed to provide improved means for delivery of successive rows of ware to the lehr.



GLASS-TRANSFER APPARATUS. U. S. 1,651,206. Nov. 20, 1927. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 3/27/24. A laying frame mounted above a moving grinding table adapted to receive a sheet of material, and two driving means for moving the frame, one means being adapted to move the frame in the same direction and at the same speed as that of the table, and the other adapted to move the frame in either direction and at a variable speed greater than that of the table.

GLASS-FORMING MACHINE. U. S. 1,650,368. Nov. 22, 1927. Richard La France, Toledo, O., assignor to the Owens Bottle Co. Filed 1/11/26. Improved means for engaging and centering the depending parison before it is enclosed in the finishing mold. The invention is adapted for use in a machine in which the bare parison after being formed in a blank mold and while supported in a neck mold, is swung downward by inverting the neck mold, thus swinging the parison from a position in which it extends upward from the neck mold, to a vertically depending position.

New Books

KOLLOIDCHEMIE. *A Textbook by Richard Zsigmondy, Professor at the University of Göttingen, Director of the Institute of Inorganic Chemistry, Fifth Edition, enlarged and rewritten. Part II, Special Part; 256 pages, one table and 16 illustrations. Size 9½ x 7 inches. Published by Otto Spamer, Leipzig. Price, in paper covers: RM. 14.00. Bound in cloth: RM. 16.00.*

The second part of Zsigmondy's monumental work on colloid chemistry, appearing in its fifth edition is now available. The first part, published in 1925 (THE GLASS INDUSTRY, Vol. 6, p. 201) contains general theories of colloid chemistry. The present volume deals with the general and practical application of the facts and theories, set forth in Volume I. Inorganic as well as organic colloids are treated. A large number of methods of preparation of colloid substances are described, including metals, non-metals, oxides, oxyhydrates, sulphides, colloid salts (inorganic and organic) organic colors and albuminous substances.

No one reading this volume can fail to be impressed by its extraordinary completeness, and by the stupendous amount of labor and effort required to produce a work of this nature. The language is plain; in this respect also the hand of a master is in evidence.

CLAY TECHNOLOGY. CERAMICS. *By Hewitt Wilson, Associate Professor of Ceramic Engineering, University of Washington, Seattle; Consulting Non-Metallic Engineer, Northwest Experiment Station, U. S. Bureau of Mines. XIV and 282 pages, size 6 x 9½ inches. Bound in cloth. Price $4.00. Published by McGraw-Hill Book Company, Inc., New York.*

There has long been a demand for a book that would contain in a condensed form the numerous facts and theories which form the basis of present day conceptions in ceramics. This volume fills the lack of such a book in an admirable way. Without going into a mass of detail that would but confuse the reader, the underlying principles of ceramics are discussed with a completeness that leaves little to be desired. In spite of the highly technical questions with which the author has to deal, their manner of treatment relieves the reader of the tedium, usually associated with subjects of this order. Ceramic processes are described briefly, the object of the author being to emphasize the fundamental principles upon which rests the science and technology of the ceramic industries.

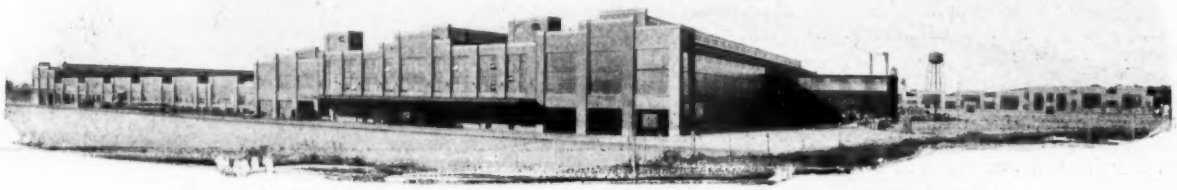
A feature of the book is the completeness of the bibliography, which is given at the close of each chapter. Some of the topics discussed are:

Classification of ceramic bodies;
Geophysical-chemical relationships;
Descriptions of types of clay;
Plasticity;
General theory of drying;
Physical changes during vitrification;
Crystalline ceramic bodies;
Heat of melting silicates;
Eutectic action;
Bowen's reaction principle;
Deformation, softening and fusion of silicates and clays;
Melting, fusion and crystallization of silicates.

Notable Feat in Factory Construction

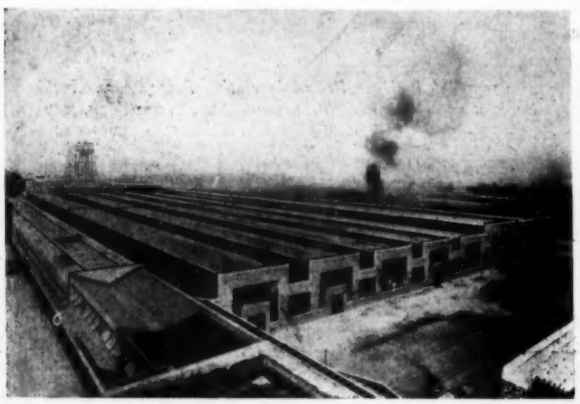
Factory building design and construction is a subject of decided importance to the glass manufacturer who contemplates the extension or rebuilding of his plant or the construction of an entirely new one. Not only must every new building be so designed that the manufacturing processes carried on within it can be facilitated to the greatest possible extent, but the time element involved in the erection of the selected type of structure is another vital factor in the ultimate success of the enterprise. Every month gained in completing the work makes possible for the owner an additional month of productive operation and shortens the time during which his investment in unfinished buildings remains unproductive.

It is worth while, therefore, in order to learn what can be accomplished in these days by a strong combination of engineering skill, executive ability and capital, to give attention to a notable example of factory construction, the largest undertaking of its kind contracted for during the year.



GENERAL VIEW OF "PONTIAC SIX" PLANT OF THE OAKLAND MOTOR CAR COMPANY

This is the new "Pontiac Six" plant of the Oakland Motor Car Company at Pontiac, Michigan, a subsidiary of the General Motors Corporation. This enormous work, the largest automobile plant project ever carried out at one time, was completed and Pontiac cars going down the assembly line less than seven



THE PLANT CONTAINS OVER 500,000 SQUARE FEET OF SKYLIGHT GLASS

months from the day when construction was started. The work was done by The Austin Company of Cleveland, Ohio, architects, engineers and builders of the entire plant, well known to the glass industry through the glass plants it has successfully designed and erected and because of its speed records in completing various building operations in this field.

The Pontiac plant is interesting not only as one of the latest examples of modern factory construction presenting ideas adaptable to glass plants but also because of the extensive use in it of window glass. As shown in the illustrations, the walls consist largely of glass, and roofs, monitors, partitions, etc., utilize it to a great extent. Over a mile of skylights containing more than 500,000 square feet of glass were built. The Oakland company's product, the "Pontiac Six" also involves the use of great quantities of automobile glass, the daily production capacity being 1,000 cars.

The entire plant comprising 35 acres of floor space, with three covered trainsheds for unloading material, and railroad and shipping "dock" is practically under one roof, and the materials from the time of their arrival at the plant are completely under cover all the way through the manufacturing and assembling and shipping operations.

The plant consists of the motor manufacturing building, 530 by 830 feet; an assembly building, 180 by 1,260 feet; and the motor car storage building, 432 by 762 feet. Adjoining and between the buildings which lie parallel to each other, and cut off from them by glass partitions, are covered unloading tracks with wide platforms to which materials are brought in cars and from which they are distributed. The manufacturing operations are laid out on a straight line system and the raw material delivered by conveyors and electric trucks directly to the place where it is to be utilized. It flows from the several unloading tracks to the buildings on either side. Motor bodies are brought from the Fisher Body Corporation factory by a quarter-mile long covered conveyor. Cranes, conveyors, lift-trucks and special labor-saving devices are also used extensively for handling materials.

In addition to the buildings it was necessary to provide roads, 8 miles of sewers and 2 miles of drains, 10 miles of railroad trackage and other extensive construction work.

Materials to the amount of 4,500 carloads were required for the three buildings; 100,000 barrels of cement were used; 2,000

GLASS WAS USED LIBERALLY IN THE ASSEMBLY BUILDING

carloads of sand and gravel, 5 carloads of nails, 20 acres of wood block floor, 45 acres of built-up water-proofing.

No word description or artist's picture can convey an adequate idea of the immensity of this plant, with its 35 acres of floor space, or what it meant to build it complete in seven months' time.

Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

Breaking Tank Glass by Compressed Air

Paving breakers recently found a new field of use in removing a solid mass of glass from a furnace in the Tygart Valley Glass Company's plant at Washington, Pa. Supplanting hand methods of demolition, these air-driven tools saved both time and money in such a convincing manner that they will be exclusively employed there hereafter for work of a similar nature. Comparative data reveal that the pneumatic method costs but 32.7 per cent. as much as handwork, that it entails only 18 per cent. as much man power, and that it effects a 58 per cent. saving in time consumed.

BETTER THAN SLEDGES, MOILS, CHISELS OR PINCH BARS

The furnace on which the test was made measures 21½x100 feet. In the bottom of this furnace was a 5-foot mass of unbroken glass —an immense slab containing 398 cubic yards. A paving breaker, weighing 50 pounds, was first tried, but it proved too light for the work. It was replaced by 80-pound CC-35 paving breakers. This type of machine turned out to be entirely satisfactory.

Moil-pointed steels of both 14- and 18-inch lengths were used. The 18-inch steels were found to be best for the purpose, as they could be driven deeper into the glass. The experiments disclosed that by employing a point slightly blunter than the standard moil point the steels did not have to be sharpened as frequently as would otherwise have been the case. The blacksmith also tried various tempering heats in reconditioning the steels. He learned that the best results were secured by bringing the point to a straw-yellow color for a distance of half an inch back from the tip, with the remainder of the point showing a blue color.

The equipment used consisted of two CC-35 paving breakers, two 50-foot lengths of ¾-inch air hose and 8 steels. Air at 90 pounds pressure was supplied; and a crew of 12 men was employed. Each paving-breaker operator had a helper who used a pinch bar to pry pieces of glass from the mass as they were broken loose. Four men passed the shattered glass out of the furnace and four others wheeled it from the building. Working in 8-hour shifts, the men accomplished the task in 15 days. One paving breaker was operated 35 hours and the other 34 hours—a total of 69 breaker-hours on the entire job.

The following cost figures of the work when done by hand and by machine should prove of interest; and, as a basis of comparison, the company used records available on the hand breaking of 267 cubic yards of glass in its own plant. Despite the fact that that mass was smaller, its removal required the services of 18 men over a period of thirty-six 8-hour days.

HAND METHOD

Labor—18 men working 36 days of 8 hours each, @ 40c an hour	$2,073.60
Equipment—sledges, moils, etc.	50.00
Total	$2,123.60
Cost per cubic yard	$7.95
Number of man-hours per cubic yard	19.37

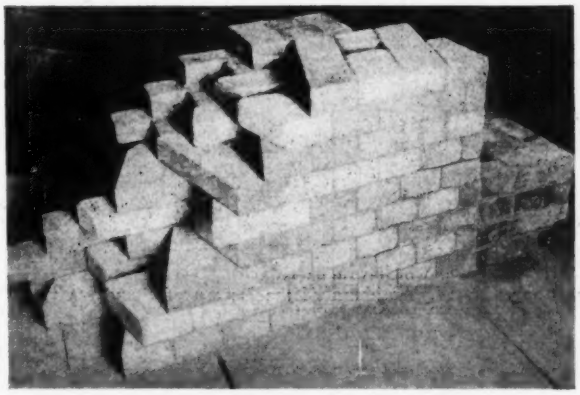
PAVING-BREAKER METHOD

Labor—12 men working 15 days of 8 hours each, @ 40c an hour	$576.00
Equipment—paving breakers, air hose, and steels	449.00
Lubricating oil	1.50
Compressed air @ 5c per 1,000 cubic feet	11.17
Total	$1,037.67
Cost per cubic yard	$2.60
Number of man-hours per cubic yard	3.61

An analysis of the foregoing tabulations brings out the following points: First, that the paving-breaker method saved $5.35 on every cubic yard of glass removed; second, that it saved 15.75 man-hours per cubic yard of glass; third, that the saving on 86 cubic yards of glass paid for the equipment, power, etc.; and fourth, that the total saving effected in disposing of the 398 cubic yards of glass with compressed air was $2,129.30. As no tool breakage occurred, the conclusion is warranted that the equipment employed is admirably suited for the purpose.—*Compressed Air Magazine.*

Biasbrix for Stronger Walls

There is always the tendency for walls to loosen up and joints to open, resulting in heat losses, slag penetration and eventual disintegration. This problem of a stronger wall is said to have been solved by the development of Biasbrix, a unique



A NEW REFRACTORY—BIASBRIX

shaped refractory. As the name implies, these bricks are laid up on the bias, one brick overlapping and tying together three other Biasbrix in a natural, self-locking construction which gives exceptionally tight joints and a wall of great strength. Owing to this peculiar construction and interlocking feature, walls laid of Biasbrix it is claimed, do not loosen up, joints remain tight and heat losses and slag penetration are reduced to the minimum.

Although different in shape, the new brick, it is said, lay up as readily as the ordinary straight brick in any thickness of wall.

Biasbrix is made oy General Refractories Company, Philadelphia. It can be furnished in both silica brick and fire brick.

The Glass World and What It Is Doing

News of the Industry

Flat Glass Makers and Distributors to Confer

A conference between the flat glass manufacturers and distributors that may develop important results in that field, has been called for at the William Penn Hotel, Pittsburgh, on January 9 and 10, by North Storms, secretary of the National Distributors Association.

The executive committee representing all divisions of the asociation will attend. The manufacturers have been invited to discuss with them the existing unsatisfactory conditions with a view to finding a remedy for them. Both manufacturers and jobbers who have constructive suggestions to offer for putting the flat glass industry on a sounder basis are requested by Mr. Storms to send them to him in advance for reference to the executive committee.

The present plan is to hold conferences with the window glass manufacturers at 9:30 a. m., Monday, January 9, with the rolled glass manufacturers at 9:30 a. m., Tuesday, January 10 and with plate glass manufacturers on Tuesday at 2 p. m.

At a meeting of the Association on December 6 and 7 held at Pittsburgh, A. B. Dwelle of the Dwelle-Kaiser Company, Buffalo, N. Y., was elected president for the coming year; George W. Patek of Patek Brothers Company, Milwaukee, Wis,: first vice-president; C. C. Belknap of C. C. Belknap Glass Company, Seattle, Wash., second vice-president. Addresses were made by W. L. Monro, president of the American Window Glass Company, H. E. Allen, vice-president Libbey-Owens Sheet Glass Company and C. J. Gundlach, president of the Mississippi Glass Company, all urging the importance of taking steps to improve conditions in the trade. Other interesting addresses and remarks were made by various members. A dinner to the glass manufacturers given by the Association and held on the evening of December 6, was greatly enjoyed.

Glass Division Will Join in Plant Trips

H. L. Dixon, chairman of the Glass Division of the American Ceramic Society, recently announced that Herman K. Kimble, and Lester M. Moss of the Harrison, N. J., Glass Works of the General Electric Company, will represent the Glass Division on the committee which will be in charge of visits to New Jersey glass plants which the members will make after the annual meeting in Atlantic City in February. J. M. Gilfillan of the Trumbull Electric Manufacturing Company, pottery division, Trenton, N. J., is chairman of this committee and members having preferences as to plants to be visited are requested to communicate with him.

Papers to be read at the Atlantic City meeting are being prepared for the Glass Division. Among others there will be: "Experiments Concerning a New Method for the Production of Refactories for Metal and Glass Industries," by H. Miller; "Determination of Iron in Glass Sand," by G. E. F. Lundell; "Glass Manufacturing in Brazil," by H. Haynes and "Glass Industry in Japan," by K. Fuwa. A paper is also being prepared by W. S. Walbridge on the life and work of E. D. Libbey and M. J. Owens, founders of the Owens Bottle Company, which will be read by James Morrison of that company. E. W. Washburn of the Bureau of Standards is expected to present a paper relating to Michael Faraday's researches in glass manufacture.

Pittsburgh Section A. C. S. Elects Officers

At a meeting of the Pittsburgh Section of the American Ceramic Society held on December 13 at the Mellon Institute, Pittsburgh, the following officers were elected: Irwin Sohn, chairman; George E. Sladek, vice-chairman; Robert F. Ferguson, secretary, and C. G. Denney, treasurer. Following the election, the evening was devoted to a discussion of art in industry. Frank Rhead spoke on the "Technical Aspects of Ceramic Art" and James C. Boudreau spoke on "The Importance of Art In Industry."

The next meeting of the section will be held on January 10 and will take the form of a smoker. Ross C. Purdy, secretary of the main society, will address the members on some observations of his recent trip to Europe.

Census Figures on Machinery Production

The final report of the Bureau of Census covering machinery made for all different industries was released in November. The total value of machinery manufactured in 1925 was $5,129,414,553. Included in the report the following industries are of more or less interest to the glass trade:

	1925	1923
Glass-making machinery	$2,665,856	$2,651,368
Incandescent lamp-making machinery	4,255,464	1,534,676
Pneumatic machinery, air compressors	29,472,834	27,762,309
Blowers and fans	16,210,436	14,385,684
Generators	23,215,976	22,743,565
Motors (not including electric fans nor starter motors for motor vehicles)	100,162,398	95,363,753
Conveying machinery	30,688,471	26,203,332
Transmission machinery	15,350,289	11,358,631
Pumps and pumping equipment, including parts and attachments	121,299,431	92,814,688

Leipzig Fair Gaining Popularity

An increase in American participation in the Leipzig Trade Fair to be held from March 4 to 10, 1928, is indicated, more than 2,000 buyers and exhibitors from all parts of the United States being expected. Fully 10,000 exhibits of more than twenty countries will be on view while the fair will be attended by upwards of a quarter of a million buyers from forty-four countries.

The Fair has trippled in size and attendance since the war

AIRPLANE VIEW OF PART OF LEIPZIG FAIR

and it is claimed offers exhibitors today an unprecedented opportunity to reach potential buyers from all parts of the world. It is estimated that the American buyers visiting Leipzig in the Spring will spend more than $2,000,000 in expenses alone.

Over one-hundred special exhibition buildings, located at various points throughout the city, house the fair. A new hall, twice the size of the Madison Square Garden in New York has been built for the special automobile exhibit of commercial cars. Additional floor space is devoted to 2,000 exhibits of textile machinery and its products. The Fair will include 1,200 exhibits of technical machinery, 700 exhibits of toys, 600 of jewelry. Glassware has always been strongly featured at this Fair.

Reliable information concerning the Fair can be obtained from The Leipzig Trade Fair, Inc., 630 Fifth Avenue, New York.

Preparing for Next Census of Manufacturers

The Bureau of the Census is making plans for the next biennial census of manufactures, which will cover the year 1927. The blank forms upon which reports should be made will be mailed by the Census Bureau to all manufacturers about January 10. A report will be required from each manufacturing establishment whose output in 1927 was valued at $5,000 or more.

Incandescent Lamp Sales

Sales of incandescent lamps in the United States during 1927 totaled approximately 320,000,000 large size and 218,000,000 small lamps, according to a review of the electrical industry for the year by John Liston, of the General Electric Company. This is an increase of about 8,000,000, or 2½ per cent, in the large sizes over 1926, and 16,000,000, or 8 per cent, in the small sizes over the previous year.

Sales the past year were the largest in the industry. In ten years the sale of large lamps has doubled and that of the small lamps has tripled. The year has also seen a noticeable increase in the sales of 10,000 watt lamps, the largest in commercial production, which were developed for motion picture studio use. These big lamps are now being widely used for aviation field lighting.

Only One Profit on Ford Motor's Glass

In one of the series of full-page newspaper advertisements signed by Henry Ford used all over the country in connection with the introduction of his new model car (a campaign which is estimated by advertising men to have cost $1,500,000 for newspaper space) Mr. Ford stated:

"We make our own steel—we make our own glass—we mine our own coal—we make virtually every part used in the Ford car. But we do not charge a profit on any of these items or from these operations. We would not be playing fair with the public if we did so. Our only business is the automobile business. Our only profit is on the automobile we sell."

November Construction Record

The total volume of construction contracts awarded in the 37 states east of the Rocky Mountains during November amounted to $466,393,400, according to F. W. Dodge Corporation. These states represent about 91 per cent of the total construction volume of the country. November's record showed a drop of 17 per cent from the total for October of this year, but was only 4 per cent under the November, 1926, record.

Repeal of Tariff Act Asked

A bill (H. R. 6667) was introduced December 12 in the House of Representatives by Representative Cordell Hull (Dem.), of Carthage, Tenn., calling for the repeal of Section 315 of the Tariff Act of 1922. This is the flexible provision which gives the President the power to increase or decrease import duties within certain limits.

Hoover Aids Chemical Industries

Secretary Herbert Hoover recently appointed eight more members to the Chemical Advisory Committee of the Department of Commerce. This committee was originally established to act as a liaison body between the chemical industry and the Department of Commerce. The membership consists largely of men prominent in the chemical indutry.

Plate Glass Production in November

The production of polished plate glass for the month of November, 1927, was 8,572,744 sq. ft., making the total production for 11 months of 1927, 103,944,648 sq. ft.

Trade Activities

John M. Berg, general superintendent of the National Plate Glass Company's plants, retired from active business on January first.

The Rolland Sheet Glass Company, Clarksburg, W. Va., started furnace fires in December at their plant which had been idle during reconstruction.

The Central States Flat Glass Company, Sandusky, O., is the new name of the Sandusky Glass Manufacturing & Supply Company. The company has been refinanced and is installing sheet glass drawing machines. It is expected that operations will begin about March 1.

The Adamston Flat Glass Company, Clarksburg, W. Va., have completed extensive additions to its production capacity begun last Spring and are adding 200 men to their pay roll.

The Celite Products Company, Los Angeles, Cal., announce the removal of their Chicago office from 53 West Jackson Boulevard to their own building at 225 East Superior Street.

The Fairfield Sheet Glass Company, Lancaster, O., operating the Libbey-Owens process, is reported to be installing new equipment and making other extensive improvements in the plant. The date on which production will be resumed has not yet been announced.

The Libbey Glass Manufacturing Co., Toledo, O., in cooperation with the Mutuelle Solvay group of capitalists will build a factory in Belgium with an annual capacity that, it is reported, will turn out about $1,000,000 worth annually of products similar to their own.

Macdonald-Perry, who specialize in trade journal advertising and who handle the account of Kirk & Blum Manufacturing Company and other advertisers, has announced through D. W. Macdonald a change in the name of their organization to Macdonald & Company. Their address is the same as before, Southern Ohio Bank Building, Cincinnati, O.

The Inland Glass Company, Chicago, Ill., has been incorporated in the state of Illinois with a capital of $75,000, to deal in glass, and glassware of all kinds, including lighting ware, with John J. Dowdle, George L. Chamberlain and Louise Chamberlain as incorporators and Timothy J. Bell, 609 West Washington Street, Chicago, Ill., as correspondent.

The Findlay Clay Pot Company of Findlay, O., and Washington, Pa. have consolidated their factories at Washington, Pa., have surrendered their Ohio charter and incorporated in Pennsylvania under the name of the Findlay Clay Products Company of Washington, Pa., under one management. They have greatly enlarged their Washington plant so as to accommodate the combined business of both factories.

The Sheffield Glass Bottle Company's plants at Sheffield and Wilcox, Pa., according to local reports, were sold at a public sale on December 14. The Sheffield plant, which was modernized in 1926, was purchased by William B. Griffin of Titusville, Pa., for the sum of $41,400, including all buildings and equipment. The Wilcox plant, which was partially damaged by fire several months ago, was sold to E. D. Aldrich of Wilcox.

The American Window Glass Machine Company, at a meetinng on December 21, decided not to declare any dividend at this time on common or preferred stock. Foreign importations and falling off in domestic consumption were cited as the reasons. Eleven Fourcault machines will shortly be placed in operation at the Belle Vernon, Pa., plant. It is said that the company has decided to produce laminated glass for automobiles and other uses.

The Zihlman Glass Company, Cumberland, Md., according to a local report had a petition filed against them asking that a receiver be appointed. Judge Albert A. Doub, Z. M. Huyett, Albert E. Zihlman, secretary of the glass company and Frank A. Trieber were named as receivers and furnished a bond in the sum of $12,000. On the evening of the day the receivers were appointed a high wind storm caused damage to the Zihlman Company's plant reported to amount to about $20,000.

The J. R. Greenlee Company, Bellaire, O., has purchased the plant of the H. Northwood Glass Company, Wheeling, W. Va. New and modern machinery is to be installed. The manufacture of tableware, lighting fixtures, novelty goods, etc., will be resumed. J. W. Fenton, who for a long time has been connected with the Fenton Art Glass Company at Williamstown, W. Va., and who recently sold his interest there to his brother, will be general manager. S. H. Waddell, will be vice-president.

Members of the **Associated Glass and Pottery Manufacturers** are preparing exhibits for the Pittsburgh exhibition to be held at Fort Pitt Hotel beginning January 9. In an item printed in the November issue it was inadvertently made to appear that the exhibition of the Western Glass and Pottery Association would be held in Pittsburgh beginning January 9. This was an error, as the Chicago association is not in any

way connected with the Associated Glass and Pottery Manufacturers and does not hold exhibits in Pittsburgh.

The Owens Bottle Company's directors at their first meeting in Charleston, W. Va., on November 30, declared the regular quarterly dividend on the preferred stock of $1.75 per share and 75 cents per share on the common stock. Also an extra dividend of $1 per share in cash and five per cent in stock, all payable on January 1, 1928, to stockholders of record at 3 o'clock, December 16. It was announced that all outstanding preferred stock will be called for redemption July 1, 1928.

The Master Auto Glass Association has been organized among automobile glass contractors of Chicago and vicinity for the purpose of promoting the general welfare of the automobile glass industry as a whole. David Glover, Auto Glass Products Company, is president; S. F. Regan, Plate Glass Shop, vice-president; Henry L. Kurtzman, Auto Glass Company, recording secretary; Michael A. Kelly, Kelly Auto Glass Company, financial secretary and business manager, and Henry Surber, Windshield Shop, treasurer, all of Chicago.

The American Blower Company and the **American Radiator Company** have been merged, bringing together two of the oldest and best equipped companies engaged in the manufacture of heating, ventilating, air conditioning and mechanical draft apparatus and allied lines, forming what is said to be the largest concern of its kind in the world. It is stated that each company will operate in the future much the same as it has in the past, as to name, personnel, business methods and management, the merger making possible important economies in buying, marketing and manufacturing.

The General Flat Glass Company of Mannington, W. Va., was put in the hands of Arthur G. Clayton as special receiver early in December. The petition stated that the company, a $500,000 corporation, is not believed to be insolvent and that the receivership action was taken to protect all creditors and the company itself during temporary financial embarrassment. Some time ago the company purchased the site and part of the equipment of the old Mannington Glass Company and has spent large sums in modernizing the factory, a number of sheet drawing machines of the Fourcault type having been installed. Operations were begun in October but the production of glass was unsatisfactory. It was also stated that as soon as additional working capital can be obtained the difficulties can be overcome and the plant can be profitably operated.

The H. L. Dixon Company, Pittsburgh, Pa., in announcing that they have obtained exclusive rights to install and equip Robertson patented continuous tunnel kilns and other equipment, state that this action was taken only after an extended investigation of the entire patent classification. They are convinced that the Robertson types far exceed others in principle, construction cost, efficiency and fuel economy. Robertson has been in the tunnel kiln business since 1916, and as a result of these years he has perfected the Robertson tunnel kilns of all types, as well as all types of heat-treating, annealing and similar furnaces, of which many are in use. With machine shop, pattern shop, foundry, forge shop and established reputation for responsibility, the H. L. Dixon Company is well able to handle all contracts within their own organization, thereby assuring their customers that all work will be done under the most advantageous conditions. Their entry into the kiln building business will in no wise interfere with the Dixon service to the glass field.

The Libbey-Owens Sheet Glass Company's report of operations and financial condition for the year ending September 30, 1927, issued December 14, shows net earnings of $2,705.672. Cash dividends amounting to $1,719,960 were paid on common and preferred stock. No extra dividend will be paid at this time. At the annual meet of the company Robert Lehman, John D. Diggers, Marshall Field and F. E. Notebaert were elected directors, succeeding H. E. Allen. Potter Palmer and H. L. Hollis. Other directors and officers were reelected. President J. C. Blair reported that results in the plate glass manufacturing department had been satisfactory and that production is being increased. The company is developing a non-shatterable glass and in the meantime will sell its share of glass consumed by makers of the non-shatterable product for automobiles. The company is doing intensive research work on the subject of ultra-violet glass. The adoption of national advertising of the company's products last July proved satisfactory.

The Interstate Window Glass Corporation of Kane, Pa., has been organized to supersede the Interstate Window Glass Company which was placed in the hands of receivers in May, 1925. The directors of the new corporation are as follows: R. A. Hill, J. B. Angloch and W. S. Calderwood of Kane; R. E. Burdick, Smethport; and K. M. Andrews, Warren. The officers elected by the new board of directors are: R. A. Hill, president; W. S. Calderwood, vice-president and J. B. Angloch, secretary and treasurer. The company's plant at Clarksburg, W. Va., has been sold and also the old Pennsylvania Window Glass Company plant at Kane, Pa., and both plants, it is reported, will be torn down. A deed for the transferring of the property and a mortgage to secure the payment of $2,221,500 worth of bonds was filed with the county clerk in Clarksburg.

The Triplex Safety Glass Company of North America, with headquarters in Hoboken, N. J., are furnishing their safety windshield glass to the Ford Motor Company for their new car on which Triplex glass is now standard equipment.

An addition of 21,000 square feet to the company plant has been announced by A. L. Haskell, president, and installation of the most modern machinery is now being completed along lines which will enable the company to triple its production. Much of the machinery is specially designed to handle the manufacture of this special type of glass. Such is a Weber edge grinder and polisher which alone will perform the delicate edge polishing work of ten men. T. H. Towers Farr, Jr., production manager of the Triplex company, states that the increased plant is made necessary by present business demands. In addition to the Ford, sales to the Chrysler, Yellow Cab, Murray body and other body builders which recently adopted Triplex, and to individual car owners have increased steadily. In the annual New York automobile salon, which took place at the Commodore Hotel from November 27 to December 3, fifteen cars were Triplex equipped as compared with four in last year's salon. Stock of the English company manufacturing Triplex glass made a sensational rise of £10 on the London stock exchange during the past two months, passing £13 on December 16. The increase is attributed to the fact that numerous automobile companies in this country have made the glass a part of their standard equipment.

Industrial Publications

Metered Combustion Control as used in a Providence, R. I., power plant, is described in a paper being distributed by the Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa. The rate of combustion is regulated according to the steam demand by a master controller connected to the steam header so that it responds to drop in pressure due to flow of steam and sets up an electrical control current proportional thereto. This current cooperates with control devices which actually meter the pulverized coal and the air supplied to burn it, to hold the two in a definite ratio and in proper amount to meet the steam demand.

Bench Edger. Henry G. Lange Machine Company, 166 North May Street, Chicago, Ill., have issued a circular introducing a new bench edger which they state is a sturdy low priced unit, capable of performing many of the simpler operations of glass edging, such as used in auto glass replacement work. The machine is furnished with or without motor and complete instructions for grinding, smoothing and polishing the edges of plate glass accompany each machine.

Glass Cutting Equipment. G. W. Klages & Son, Inc., 2232 Koerner Avenue, Pittsburgh, Pa., are issuing a folder devoted to their line of glass cutting equipment, which includes cutting tables, plain rules, test squares, cutting wheels, pliers, circle sweeps, etc. Another feature is Klages combination oval circle cutters. Miscellaneous tools include plate glass strippers, fraction gauges, swivel heads for pattern work, notched gauges and other special gauges.

Dust Respirators. Their Construction and Filtering Efficiency. Technical Paper 394. Bureau of Mines, sold by Superintendent of Documents, 52 pages. Treats of dust respirators which should be and are used to some extent in handling soda ash and other materials used in glass making.

Centrifugal Air Compressors. General Electric Company, Schenectady, N. Y., has issued Bulletin GEA-233A on single stage centrifugal air compressors, a type introduced about 20 years ago by this company. This type of compressor has been successfully applied to all classes of service where air is required. Seventy-five of the original sizes have been redesigned recently with greatly improved efficiency. The volume range of these compressors is 250 to 75,000 cu. ft. per min. The 250 cu. ft. unit can be built for pressures of from 1 to 4 pounds. A chart showing curves of tests on these machines is shown.

Personals

J. B. Krak, Technical Editor of The GLASS INDUSTRY, sailed December 30 on a two months' trip to study the glass industries of the principal European glass producing countries. Mr. Krak has been appointed Glass Technologist in the ceramic department of The Roessler & Hasslacher Chemical Co., Perth Amboy, N. J., effective March 1, to take charge of all glass research and technical service work in connection with the manufacture and sale of glassmakers' chemicals. In his new position Mr. Krak will continue his connection with The GLASS INDUSTRY as Technical Editor.

Charles A. Young of the Macbeth-Evans Glass Company, Pittsburgh, Pa., has been elected president of the Pittsburgh Association of Manufacturers' Representatives, **Walter H. Burns,** is first vice-president and **Edward A. Bracken,** of the Pacific Coast Borax Company, second vice-president.

J. J. Kelley, for the past several years Chicago representative of the Libbey-Owens Sheet Glass Company, has resigned and is now general sales manager of the Blackford Window Glass Company, Vincennes, Ind.

Recent Deaths

William E. Parker

William E. Parker, who retired as manager of the Cincinnati branch of the Pittsburgh Plate Glass Company in 1920, after serving fifteen years in that capacity, died at his home in Detroit on November 15. William E. Parker, Jr., has succeeded his father as manager of the Cincinnati territory.

Dr. I. C. White

Dr. I. C. White, state geologist of West Virginia, specializing in the gas and coal industries, died at Baltimore on November 25, at the age of 79. Dr. White made his home in Morgantown, W. Va., and was the oldest living graduate of the University of West Virginia.

Samuel S. Marshall

Samuel S. Marshall, for many years connected with the stained glass firm of S. S. Marshall & Bro. until his retirement about ten years ago, at which time the company also ceased activities, died at his home in Swissvale, Pa., at the age of 78.

John W. Gundling

John W. Gundling, son of Mr. Gundling of the Nivison-Weiskopf Company, Cincinnati, O., and who was employed in the engineering department of that company, died at his home in that city on November 20.

Cuno F. Sauer

Cuno F. Sauer, president of the American Glass Works, Inc., Richmond, Va., died at his home in that city the latter part of November.

Coming Meetings

The American Ceramic Society's annual meeting will be held at the Ambassador Hotel, Atlantic City, N. J., February 5 to 11, 1928. This will be a joint meeting of the National Brick Manufacturers Association and Heavy Clay Products Division. The European tour of Society will cover the period from May 19 to July 5, 1928, and will include visits to England, Germany, Czechoslovakia, France, Holland.

The Artistic Lighting Equipment Association will hold its annual meeting at the Hotel Winton, Cleveland, Ohio, January 25 to 28 inclusive.

The National Glass Distributors Association will hold its next meeting at the William Penn Hotel, Pittsburgh, on January 9 and 10. The executive committee will confer with manufacturers and jobbers.

Inquiries Received

For further information address THE GLASS INDUSTRY

396. Would you be kind enough to give me the name and address of some concern which can furnish glass tubing one inch in diameter? (Dec. 15.)

What the World Wants

Specific Inquiries for American Goods, Received in the Department of Commerce, Washington, D. C.

Holland: 28399, glassware.

Porto Rico: 28376, glassware, pressed, glass lamps and chimneys.

Canada: 28379, Indicating and recording pyrometers.

Denmark: 28416, bottle-making and capping machinery.

Egypt: 28442, glass for mirrors; glassware, especially plain, fancy and cheap glasses and pitchers.

Colombia: 28576, window and door glass.

Argentina: 28587, colored and iridescent glassware.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, DECEMBER 22, 1927.

Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa

	Bid	Asked	Last
American Window Glass Machine, com.	17	20	18
American Window Glass Machine, pfd.	..	..	42
American Window Glass, pfd.	..	...	85
United States Glass	15	...	16
Pittsburgh Plate Glass, com.	..	227	224
Standard Plate Glass, com.	..	...	2
Standard Plate Glass:			
Preferred cumulative	..	...	12
Prior preferred	*23	...	25

* Last quotations previous to yesterday.

TOLEDO, O., DECEMBER 22, 1927

Owens Bottle, pfd.	115	117	116
Libbey-Owens Sheet Glass, com.	130	135	132½
Libbey-Owens Sheet Glass, pfd.	115½	117½	116

WHEELING STOCK EXCHANGE, DECEMBER 22, 1927.

	Bid	Asked	Last
Hazel-Atlas	74	75	74½
Imperial	..	..	72
Fostoria	..	..	208
Centrai	..	..	75
Jefferson, Pfd.	..	..	96

READERS WANTS AND OFFERS

For Sale: CULLET of all Descriptions
Free from Caps, Wires, etc.
GEORGE F. BAUMANN, Dealer,
1110 Carroll Street, Brooklyn, New York.
Carloads Ready for Immediate Shipment.

FOR SALE: O'NEILL MACHINES AND FEEDERS. One No. 25 and three No. 30 machines with the like number of feeders, all in good condition. Address: Box "E," Royersford, Pa.

Current Prices of Glass-Making Materials

December 22, 1927

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.44½	.44½
Hydrochloric (HCl) 20° tanks, per 100 lb.		..	1.05-1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.36	.36
Alcohol, denatured	gal.	..	.48½
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.19-.21
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.10⅝-.10⅞
Antimony oxide (Sb_2O_3)	lb.	..	.14-.16
Antimony sulphide (Sb_2S_3)	lb.	.15	.16
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.04¼-.04½
Barium carbonate ($BaCO_3$)			
Precipitated	ton	53.00	58.00
Natural, powdered, imported	ton	48.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.03¾	.04-.04½
Boric acid (H_3BO_3)	lb.	.08-.08¼	.08¼-.09
Refined	lb.	.08-.08¼	.08½-.08¾
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.10-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.28
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	..	.30
Cryolite (Na_3AlF_6) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.30
Feldspar—			
100 mesh	ton	11.00-20.00	15.50-22.00
80 mesh	ton	..	14.50
40 mesh	ton	12.50	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	.08½	.09
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.03¼-.07
Black (FeO)	lb.	.03½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.09-.10	.10-.10¼
Litharge (PbO)	lb.	.08-.09	.09-.09¼
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	11.50-12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.05-.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07½-.08
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black—			
for nickel content	lb.	..	.35
Nickel monoxide (NiO), green—			
for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	23.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08½
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06⅝	.07⅛
Hydrated 80-85%	lb.	.06	.06½
Potassium chromate (K_2CrO_4)	lb.	..	.28
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.15	.15½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.40¼-.42
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	2.40
In bags	Per 100 lb.	1.37½	..
Spot orders..02½-.05 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06½
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	3.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03¾	.04
95 per cent	Per 100 lb.	2.45	2.80
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½-.06
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.25
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.41	.41½
Tin oxide (SnO_2) in bbls.	lb.	.62	..
Uranium oxide (UO_3) (black, 96% U_3O_8)			
100 lb. lots	lb.	..	1.25-2.25
Zinc oxide (ZnO)	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to November 23, 1927

	October 1926 Quantity	October 1926 Value	October 1927 Quantity	October 1927 Value	Ten Months Ending October 1926 Quantity	Ten Months Ending October 1926 Value	Ten Months Ending October 1927 Quantity	Ten Months Ending October 1927 Value
Glass and glass products (total)	.....	885,906	.....	791,581	.....	7,612,858	.....	7,397,707
Plate and window glass—								
Window glass, common, box 50 sq. ft.	1,881	12,922	1,236	7,654	26,141	154,493	19,223	104,230
Plate glass, unsilvered, sq. ft.	27,034	9,953	104,661	30,934	790,622	217,159	874,280	279,616
Other window and plate glass lbs.	195,848	15,528	234,407	27,856	1,892,883	197,915	3,520,665	365,457
Glass containers (bottles, vials and jars)	.....	381,093	.....	274,837	.....	2,655,058	.....	2,619,039
Table glassware, plain	.....	155,578	.....	136,867	.....	1,376,336	.....	1,198,415
Table and other glassware, cut or engraved	.....	14,812	.....	13,751	.....	147,315	.....	116,820
Lamp chimneys and lantern globes lbs.	111,673	25,000	107,286	21,118	1,746,526	330,460	1,540,728	314,569
Globes and shades for lighting fixtures lbs.	165,653	60,170	123,349	43,184	1,467,305	490,686	1,368,239	500,081
Chemical glassware lbs.	20,547	16,805	24,312	19,699	184,654	167,648	178,015	158,439
Electrical glassware, except for lighting lbs.	115,561	22,496	165,394	15,504	4,285,939	395,178	1,905,991	195,831
Other glassware	.....	171,549	.....	200,177	.....	1,480,610	.....	1,545,210

IMPORTS

Corrected to November 23, 1927

Glass and glass products	.....	2,050,962	.....	1,595,644	.....	17,562,803	.....	14,157,863
Cylinder, crown and sheet—								
Unpolished dut. lb.	5,992,448	234,412	.....	.....	66,582,849	2,660,928	.....	.....
Weighing less than 80 pounds per case dut. lb.	.....	.....	3,685,647	107,931	.....	.....	40,223,222	1,057,237
Weighing 80 pounds or over per case dut. lb.	.....	.....	2,683,959	115,213	.....	.....	33,027,531	1,410,264
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	49,207	.....	33,775	.....	463,124	.....	322,823
Plate glass dut. sq. ft.	2,203,051	782,434	.....	.....	22,579,408	7,463,756	.....	.....
Polished, unsilvered dut. sq. ft.	.....	.....	1,028,367	270,718	.....	.....	13,270,414	3,768,962
Other dut. sq. ft.	.....	.....	113,319	29,216	.....	.....	1,041,511	250,329
Bottles, vials, jars, demijohns and carboys, molded or pressed dut.	.....	21,203	.....	11,178	.....	228,707	.....	159,168
Table and kitchen utensils dut.	.....	15,309	.....	36,827	.....	82,176	.....	142,739
Glassware, cut or decorated dut.	.....	367,108	.....	462,474	.....	2,404,221	.....	3,102,924
Blown glassware, n. e. s.—								
Bottles, ornaments, gauge glasses and other n. e. s. dut.	.....	367,605	.....	241,249	.....	1,661,545	.....	1,420,488
Bulbs for electric lamps dut. No.	753,961	11,591	1,271,009	15,850	15,847,413	178,465	12,094,645	121,407
Chimneys, globes, shades, prisms and other illuminating glassware dut.	.....	70,990	.....	95,783	.....	826,836	.....	765,777
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	32,671	.....	42,636	.....	455,759	.....	440,129
Other glassware dut.	.....	98,432	.....	132,794	.....	1,137,286	.....	1,195,616